A star (*) indicates that the Abstract deals with Apparatus and Instruments.

MARCH, 1935.

GENERAL PHYSICS.

ADSORPTION.

934. Adsorption Isotherm. K. Fischbeck, H. Maas and Hertha Meisenheimer. *Zeits. f. phys. Chem.* 171. *Abt.A.* 5–6. *pp.* 385–398, *Dec.*, 1934.—Langmuir's adsorption-isotherm, $X = Ap_1/(C + p_1)$, giving the surface-concentration X, of gas adsorbed to the surface of a solid, as a function of gas-pressure p_1, is amplified by distinguishing between primary adsorption, *i.e.*, gas held by chemically active (polar) centres and secondary adsorption, *i.e.*, that held (" in solution ") in the surface layer under van der Waals molecular attraction ; the latter becomes of greater importance at low temperatures. The modified adsorption-isotherm, *viz.*, $X = (Ap_1 + Bp_1^2)/(C + p_1)$, is shown to apply more closely than Langmuir's equation to published data for the adsorption of CO_2 to charcoal (Magnus and Cahn) and to glass (Durau). The further application is considered, using Katz' data, of the adsorption of water, with swelling, to aluminium silicate, CO-haemoglobin, nuclein, elastin, (crys.) amylodextrin and erythrogranulose. The necessary modifications in the Langmuir equation to cover simultaneous adsorption of two gases are analysed. L. V. C.

935. Dynamical Method for the Study of the Surfaces of Powders. G. Schmidt. *Zeits. f. phys. Chem.* 171. *Abt.A.* 5–6. *pp.* 289–319, *Dec.*, 1934.—In this new dynamical method a small quantity of the powder is enclosed in a glass sphere which is rotated uniformly about a horizontal axis, the powder thus acquiring a " turbulent " motion which, at a suitable speed of rotation, gives a single ring of powder just fitting the vertical diametral plane of the sphere. The steady couple required at this point is designated the " ring-loading " which can be critically measured and is interpreted as a function of the surface properties of the powder. Data are given for CuO, ZnO, Cr_2O_3 and V_2O_5 and mixtures thereof, as functions of the temperature and of the nature and pressure of the gas in contact with the powder. Results in these cases are largely affected by the gaseous atmosphere owing to adsorption and are considered in relation to the catalytic properties of these oxides. L. V. C.

See also Abstracts 1193, 1295.

ATOMIC AND MOLECULAR STRUCTURE.

936. α-Particles in Light Nuclei. E. Gapon and D. Iwanenko. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 275–277, *Nov.* 21, 1934. *In English.*—When the differences in the mass defects (calculated, *e.g.*, for Li^6 as Li^6 + neutron – Li^7, the mass of the neutron being taken as 1·0078) are plotted against the atomic weights of the isotopes a curve is obtained showing maxima for atomic weights 4, 8, 12, and 16, beyond which data are doubtful. This is deemed to point to the existence of α-particles as such in at least the lighter nuclei [see Abstract 5065 (1932)]. C. A. S.

937. Nuclear Structure and Artificial Radioactivity. G. Guében. *Ann. Soc. Sci. de Bruxelles,* 54. *pp.* 215–223, *Dec.* 17, 1934.—Walke's hypothesis that every nucleus is of the form $x\alpha + y\pi_2 + zn$ (α, π_2, n representing respectively the α-particle, deuton and neutron) with $y = 0$ or 1, is applied to artificially radioactive elements. By noting that the nuclear formulæ for such elements are of certain types which do not occur for non-radioactive elements, several intrinsically unstable nuclear combinations are derived. With this information, possible reactions of α-particles, protons, neutrons and deutons with nuclei are deduced and compared with such reactions as have been observed up to now. The agreement is on the whole satisfactory and favourable to Walke's general formula. W. S. S.

938. Nuclear Synthesis and Isotopic Constitution. H. J. Walke. *Phil. Mag.* 19. *pp.* 33–59, *Jan.*, 1935.—The author's views [see Abstracts 2823 (1934) and 8 (1935)] that the elements have been evolved as the result of a continuous synthesis due to neutron capture and the β-radioactivity of the isotopes so formed, supposed unstable and so missing, the resultant protons, diplons, or α-particles being sometimes (specially in the case of the lighter elements) absorbed into the nucleus, are exemplified in detail in the cases of Li^{7}_{3}, Li^{6}_{3}, B^{11}_{5}, and B^{10}_{5}, and then applied to explain the evolution of a large number of the other elements. As a result the probable existence of slight radioactivity in several elements (*e.g.*, Sn^{121}_{50}, Hg^{203}_{80}, Tl^{203}_{81}, etc.) is predicted; as also of a number of additional probably stable isotopes (*e.g.*, As^{73}_{33}, $\mathrm{Pd}^{104,\,105,\,106,\,108,\,\&\,?\,100,\,102,\,110}_{46}$, $\mathrm{Ni}^{61,\,62,\,64}_{28}$, $\mathrm{Cd}^{104,\,106,\,108}_{48}$, Co^{57}_{27}, etc.). Some of these ($\mathrm{Ni}^{61,\,62}_{28}$, $\mathrm{Cd}^{106,\,108}_{48}$, and Co^{57}_{27}) are noted as reported since the paper was written. C. A. S.

939. Attempt to Detect the Neutrino. M. E. Nahmias. *Cambridge Phil. Soc., Proc.* 31. *pp.* 99–107, *Jan.*, 1935.—With a source of 7 mg. Ra D + E + F, surrounded by 95 mm. Pb, 11 cm. from the centres of two Geiger-Müller counters connected in parallel and shielded on all sides by 45 mm. Pb, the whole arrangement being placed 30 m. below the surface of the earth to avoid any effects of cosmic rays, the number of kicks was practically identical with that found when the source was absent, the neutrinos certainly not producing as much as one kick per minute. A similar result was obtained with a source of 4·9 gm. Ra surrounded by 1 m. of Pb. By Bethe's theory [see following Abstract] this implies that the neutrino does not produce as much as one primary ionisation in passing through 33,000 km. of air at N.T.P., a figure raised to 210,000 km. if Bethe's view is accepted that the neutrino not only ionises but also produces fast secondary electrons. From this it is further deduced that a neutrino cannot have a magnetic moment $> 2{\cdot}5 \times 10^{-4}$ Bohr magneton. C. A. S.

940. Ionisation Power of a Neutrino with Magnetic Moment. H. A. Bethe. *Cambridge Phil. Soc., Proc.* 31. *pp.* 108–115, *Jan.*, 1935. —The number of ions produced by a neutrino, if its magnetic moment is n Bohr magnetons, is shown be to $103n^2$ per km. in air at N.T.P., and is practically the same whether the mass of the neutrino is assumed to be nil or equal to that of an electron. A comparatively large fraction of the secondary electrons produced have high energy, and may therefore be counted if produced in the wall of the Geiger-Müller counter instead of in the counter itself. [See preceding Abstract.] C. A. S.

941. Artificial Radioactivity. K. Sitte. *Comptes Rendus*, 200. *pp.* 308–310, *Jan.* 21, 1935.—The theories regarding artificial radioactivity of the author and Beck, and of Fermi [see Abstracts 5248 (1933) and 1547 (1934) respectively], are discussed with reference to the half-life periods, energies of the upper limits of the β-ray spectrum, and the quantum number, j, in regard to $^{13}_{7}$N, $^{28}_{13}$Al, $^{27}_{14}$Si, and $^{30}_{15}$P, for which if $j = 2, 2, 2$, and 3 respectively mean life periods are deduced slightly less than those given by experiment. It is concluded, however, that further data are necessary before a definite decision between the theories can be arrived at. C. A. S.

942. Disintegration of Beryllium by γ-Rays. Absorption of Emitted Neutrons. Effective Cross-Section of γ-Rays. W. Gentner. *Comptes Rendus*, 200. *pp*. 310–312, *Jan*. 21, 1935.—Screens of Pb of varying thickness, *a*, were placed between a source of γ-rays from Ra B + C and Be, and the emitted neutrons counted after passage through a further thickness of Pb of 7 cm. The proportions absorbed by this 7 cm. Pb amounted to 37, 29, and 27 % when *a* was 0, 0·35, and 0·75 cm. respectively; with old MsTh as source and $a = 0$ the proportion was 22 %. The rapid decrease from 37 to 29 % is attributed to suppression of neutrons corresponding to the γ-rays of $h\nu = 0{\cdot}612 \times 10^6$ eV. By comparing the production of neutrons by bombarding Be with γ- and with α-rays the cross-section for disintegration of γ-rays of Ra B + C is deduced as 2×10^{-28} [see Abstract 12 (1935)]. C. A. S.

943. Disintegration of Nitrogen by Neutrons. F. N. D. Kurie. *Phys. Rev*. 47. *pp*. 97–107, *Jan*. 15, 1935.—Measurements made on 29 Wilson cloud chamber photographs of the disintegration of N by artificially produced neutrons (Be + deutons) are presented and discussed. It is shown that the loss in kinetic energy can be satisfactorily accounted for by postulating the momentary production of a radioactive nitrogen N^{15} by a radiative capture of the neutron. This N disintegrates with the emission of α-particles so that the half-life on the Gamow theory is around 10^{-20} sec. A distinction is thus made between nuclear transformations in which the energy absorbed is a constant (such as in the case of the disintegration of N by α-particles) and those in which the proper disintegration energy E is a constant. Disintegrations caused by neutrons are, as far as the data from cloud chamber measurements go, all of this latter type. For N E is found to be 3·1 MV. The scatter of the values of E is probably all to be attributed to experimental error but may in part be due to the short life of the radioactive N^{15}. The energy level from which the α-particle leaves the N^{15} nucleus is roughly identified with the resonance level through which an α-particle may enter a B^{11} nucleus in the reverse reaction. A mass for the radioactive N^{15} of 15·0166 is proposed on the basis of the mechanism here discussed. The data of other workers on the transmutation of O, F and Ne are reviewed in the light of these considerations and lend support to them. The values found for E are nearly the same for all of the four elements on which data exist. AUTHOR.

944. Artificial Transmutation using the Cloud-Track Method. P. I. Dee. *Roy. Soc., Proc*. 148*A*. *pp*. 623–637, *Feb*. 15, 1935.—A study has been made of the tracks produced in a cloud chamber when heavy hydrogen is bombarded by artificially accelerated diplons. It has been found that the products of the transformation are emitted in opposite pairs of ranges 15·3 and 1·7 cm. respectively. This is in accordance with the reaction ${}_1H^2 + {}_1H^2 \rightarrow {}_1H^1 + {}_1H^3$ when momentum and energy are conserved. An examination has been made of the effect of the speed of the bombarding diplons on the ranges of the particles appearing in the transformation. An investigation of the neutron emission during the same bombardment from photographs of the tracks of recoiling nuclei gives an energy value for the neutrons of $1{\cdot}8 \times 10^6$ eV. The short-range products of the disintegration of lithium by protons have also been studied with the expansion chamber. Strong evidence in favour of the reaction ${}_3Li^6 + {}_1H^1 \rightarrow {}_2He^4 + {}_2He^3$ has been obtained since the products are shown to be emitted in opposite pairs and the ranges to be in agreement with the energy balance of the reaction. AUTHOR.

945. Relative Abundance of Oxygen Isotopes, $O^{16} : O^{18}$ in Stone Meteorites. S. H. Manian, H. C. Urey and W. Bleakney. *Am. Chem. Soc., J.* 56. *pp.* 2601–2609, *Dec.*, 1934.—Powdered samples of three stone meteorites and two terrestrial rocks were, to the extent of about 50 %, decomposed by CCl_4 at 1000°, and the O obtained as CO, part of which was converted to H_2O, of which the density was determined, and then partly electrolysed. The resultant CO, H_2O and O_2 were all examined in the mass spectrograph. No difference between the isotopic constitution of the meteoritic and terrestrial O exceeding experimental error was detected. The ratio $O^{16} : O^{18} = 514 \pm 13 : 1$ for O of either origin. C. A. S.

946. Thermal Conductivity Method for Determination of Heavy Hydrogen. H. Sachsse and K. Bratzler. *Zeits. f. phys. Chem.* 171. *Abt.A.* 5–6. *pp.* 331–340, 1934.—A method is described which can be used for the determination of the concentration of D_2 in small quantities of H_2. Use is made of the normal hot-wire method of measuring thermal conductivities. Two similar elements containing the gases to be compared are connected in opposite arms of a bridge, and maintained at equal external temperatures by being embedded in a block of Cu. The temperature of the wire depends on the conductivity of the gas and the apparatus is calibrated by using hydrogen mixed with a known amount of either Ne or D_2. R. W. P.

947. Hydrogen Isotope of Atomic Weight Two. H. C. Urey and G. K. Teal. *Rev. Modern Physics*, 7. *pp.* 34–94, *Jan.*, 1935.—A summary is given of present knowledge of this subject under the headings: Historical introduction; methods of detection and analysis and the abundance of D_2; methods of separating H_2 and D_2; physical properties of H_2 and D_2 and their compounds; chemical kinetics of H_2 and D_2; nuclear spins and moments and the ortho-para conversions; spectra of D_2 and its compounds; Bibliography. T. H. P.

948. Electrolytic Separation of Diplogen. W. W. Sawyer. *Cambridge Phil. Soc., Proc.* 31. *pp.* 116–118, *Jan.*, 1935.—Bell and Wolfenden [see Nature, 133, *p.* 25, 1934] have shown by actual experiment that the efficiency of the electrolytic concentration of diplogen is independent of various factors, and that this is in accordance with theory provided that the term γ [see Abstract 1462 (1932)] is independent of the mass of the isotope, contrary to Bell's opinion [see Abstract 1772 (1934)]. This is shown to be the case to at least a higher degree of approximation than required by experiment. C. A. S.

949. Constitution of Water in Electrolytes. C. S. S. Rao. *Indian Journ. Phys.* 9. *pp.* 195–230, *Nov.*, 1934.—A study of water in solutions of electrolytes, using the Raman effect. It is found that the water band is always sharper with electrolytes than with pure water. With increasing concentration, the band gets sharper and shifts to larger frequencies for solutions of nitric acid, sulphuric acid, and sodium nitrate. The opposite occurs for HCl solutions. If solutions, whether of acids or salts, at the same concentration are compared, differences are found in the positions of the band. If the solutions have the same molar concentration, the position of the band is much more constant. The water band for solutions of sodium nitrate is much sharper than for nitric acid. It is concluded that the results fit in best with the assumption of three degrees of polymerisation in water; H_2O, $(H_2O)_2$ and $(H_2O)_3$, the dihydrol being the most common in the solutions studied. A. C. M.

950. Allotropy of Sulphur. K. Neumann. *Zeits. f. phys. Chem.* 171. *Abt.A.* 5-6. *pp.* 399–415, 1934.—Measurements of the molecular weights of the vapours over the solid modifications of sulphur between 60° and 100° C. give the molecular magnitude S_8 for S_α and S_β. A second monoclinic form of sulphur is shown to exist, and its preparation is described. The older work on insoluble sulphur ($S\mu$) is discussed and the results of molecular weight measurements are given which show that the vapour contains smaller molecules than S_8, these being probably identical with Aten's $S\pi$; $S\mu$ is a product of the polymerisation of such smaller molecules. The significance of the swelling substance for the elastic properties of plastic sulphur and of Trillat and Forestier's sulphur threads is discussed. T. H. P.

See also Abstracts 952, 1095, 1142, 1143, 1155, 1158, 1160, 1163, 1168, 1180, 1190, 1196, 1205, 1240, 1241, 1261.

COLLOIDS.

951. Visco-Elastic Properties of Rubber. J. C. Eccles and J. H. C. Thompson. *Roy. Soc., Proc.* 148*A*. *pp.* 171–185, *Jan.* 1, 1935.—The paper gives an account of an investigation of the visco-elastic properties of rubber by means of observations on the damping of forced longitudinal vibrations. Two sets of experiments are described in detail. One series of experiments refers to pure black rubber. Figures are given for the visco-elastic limits of rubber, the normal visco-elastic constants and the coefficient of normal viscosity. [See Abstract 2174 (1933).]
J. K.

952. Swelling of Gelatin in Deuterium Oxide. H. Q. Woodard and L. C. Chesley. *Am. Chem. Soc., J.* 56. *pp.* 2562–2563, *Dec.,* 1934. —Gelatin swells 86 % as much by weight in 90 % D_2O, and 93 % as much in 42 % D_2O, as it does in ordinary water. The difference is not due to a delay in the establishment of equilibrium between gelatin and D_2O.
AUTHORS.

See also Abstracts 962, 963, 966, 1216, 1219, 1256, 1290.

CRYSTAL STRUCTURE AND PROPERTIES.

953. Energetics of Surface Processes. W. Kossel. *Ann. d. Physik,* 21. 5. *pp.* 457–480, *Dec.,* 1934.—The problem of the growing crystal is discussed from two points of view. (1) The ideal plane limiting faces of the formed crystal are regarded as possessing a specific surface energy, and the energy values coming into play as these faces are steadily displaced are considered. When reduced to two dimensions, this classic theory of Gibbs, known as the continuum theory, forms the basis of Volmer's recent considerations on face nuclei. (2) The processes involved in the construction of the crystal from the separate structural units are studied—the molecular theory. Each of these theories is examined in the light of the literature of the subject and the implications involved in the two cases are compared. T. H. P.

954. Relation between Direction and Translation Mechanism in Rock-Salt Crystals at High Temperatures. H. Wolff. *Zeits. f. Physik,* 93. 3–4. *pp.* 147–165, *Jan.* 4, 1935.—Three different kinds of glide-planes are recognised for the first time. A general rule emerges that the traces of the glide-planes are more rectilinear (*i.e.*, more crystallographic) the smaller the angle between the gliding direction and the face corresponding to the trace. F. I. G. R.

955. New Translation-Condition. A. Smekal. *Zeits. f. Physik*, 93. 3–4. *pp.* 166–172, *Jan.* 4, 1935.—It appears from work upon rock-salt that among crystallographically equivalent or non-equivalent kinds of glide-planes, that particular kind is preferred which is associated with the shortest effective glide-direction. F. I. G. R.

956. Configuration of the Triiodide Group in Ammonium Triiodide Crystals. R. C. L. Mooney. *Zeits. f. Krist.* 90. *pp.* 143–150, *Feb.*, 1935. *In English.*—The crystal structure of ammonium triiodide has been determined, the iodine positions from intensity measurements, the ammonium positions largely from assumptions of interatomic distances. The orthorhombic cell has the dimensions, $a = 6\cdot64$ Å, $b = 9\cdot66$ Å, $c = 10\cdot82$ Å, and contains four molecules. The space group is *Pmcn* (V_h^{16}). The triiodide group is linear, with spacings between the atoms of 2·82 Å and 3·10 Å. The difference in spacing possibly indicates a difference in binding, but may be due to small inaccuracies in the positions. The ammonium is coordinated with eight iodine atoms at 3·73 Å and 4·1 Å. The average distance of nearest approach of iodine to iodine not in the same group is 4·28 Å. AUTHOR.

957. Crystal Morphology of Quartz. Part IV. Mineralogical Considerations. G. Kalb. *Zeits. f. Krist*, 90. *pp.* 163–185, *Feb.*, 1935. —Form-development only completely accomplished for zones $(11\bar{2}0)$ and $(1\bar{1}\bar{2}3)$. Under various circumstances, certain (positive) faces are bright, other (negative) faces, striped. [For Parts I–III see Abstract 432 (1934).] F. I. G. R.

958. Structure of the Alums. H. Lipson and C. A. Beevers. *Roy. Soc., Proc.* 148*A*. *pp.* 664–680, *Feb.* 15, 1935.—The complete structure is expressed by :—

$a_0 = 12\cdot13$ Å. Space-group = Pa3.
4 Al on (ooo), etc.,
4 K on $(\frac{1}{2}\frac{1}{2}\frac{1}{2})$, etc.,
8 S on (0·31 0·31 0·31), etc.,
8 O on (0·24 0·24 0·24), etc.,
24 O on (0·30 0·27 0·43), etc.,
24 H_2O on (0·02 0·02 0·16), etc.,
24 H_2O on (0·04 0·13 0·30), etc.

In this structure the two sets of waters are of essentially different natures. One set forms octahedral groups around the aluminiums, each of the waters having a plane distribution of its three bonds. The other set links together the SO_4 tetrahedron, the $Al\cdot 6H_2O$ octahedra, and the K atom. Each of these waters touches two oxygens, one Al water and one potassium atom, and the arrangement of the bonds is approximately tetrahedral. Some of the properties of the alums are discussed. AUTHORS.

959. Structure of Cæsium Enneachlordiarsenite, $Cs_3As_2Cl_9$. J. L. Hoard and L. Goldstein. *J. Chem. Phys.* 3. *pp.* 117–122, *Feb.*, 1935.—$Cs_3As_2Cl_9$ is shown to have a hexagonal unit of structure with $a_0 = 7\cdot37$ Å, $c_0 = 8\cdot91$ Å, containing one molecule. The atomic arrangement is based upon closest-packing of cæsium and chlorine, with $D_3^3 - C32$ as the most probable space-group, but the amount of distortion from the closest-packed positions is not large enough to permit of the unambiguous elimination of $D_{3d}^3 - C\bar{3}m$. A structure based upon D_3^2 accounts well for observed intensity data. Arsenic is shown definitely by the intensity data to have only a pseudo-coordination number of six, and the structure may be qualitatively described as containing $AsCl_3$ molecules embedded in an environment of cæsium and chloride ions in such a way that all large atoms fit into an approximately closest-packed arrangement. This is the first structure of this type to be discovered. The ratio of 3Cl per Cs is a particularly happy one for structures of this kind, and a study of this structure gives much insight into the existence and stability of the related group of compounds discussed in the introduction.

AUTHORS.

960. Constitution of Lithium Nitride. E. Zintl and G. Brauer. *Zeits. f. Elektrochem.* 41. *pp.* 102–107, *Feb.*, 1935.—With the aid of Weissenberg, rotating crystal, and powder diagrams, it is shown that lithium nitride has not the cubic molecule lattice formerly ascribed to it. It crystallises in the hexagonal system: $a = 3{\cdot}658$, $c = 3{\cdot}882$ Å, and unit cell contains 3 Li^+ and 1 N_3^-. The calculated and experimental densities are respectively 1·28 and 1·3. The only arrangement compatible with the intensities and the X-ray symmetry is a coordination lattice in which N_3^- is surrounded by 8 Li^+ and Li^+ by 2 or 3 N_3^-. By comparison of ionic lattice types of frequent occurrence, it is shown how the lattices of Li_2O and Li_3N are derivable as anion gap-structures from LiF by replacement of $6F^-$ by $3O^{--}$ or $2N_3^-$.

T. H. P.

961. X-Ray Investigation of Ergosterol and Cholesterol Derivatives. G. E. R. Schulze. *Zeits. f. phys. Chem.* 171. *Abt.A.* 5–6. *pp.* 436–444, 1934.—The unit cells of the following have been determined:

	a (Å)	*b* (Å)	*c* (Å)	*β* (°)	*d*
(i) Ergosterol acetate	34·8	7·58	10·48	92·6	1·05
(ii) Ergosterol acetate-maleic anhydride, I	31·1	9·58	10·60	95·0	1·13
(iii) Do. Do. Do. II	32·2	7·91	25·3	92·1	1·11
(iv) Cholesteryl acetate	16·3	9·35	17·5	73·6	1·11
(v) Cholestanedione	19·6	7·62	7·9	93·	1·13
(vi) Cholestane dibromide	20·8	11·27	10·72	90·	1·40
(vii) Hydroxycholestenone dibromide ...	15·35	7·58	11·55	93·7	1·36
(viii) Acetoxybisnorallocholanic acid ...	57·1	7·69	19·45	97·5	1·21

It is concluded that all four rings and the 9C chain in the ergosterol molecule lie in the *a-c* plane, the molecules being arranged in pairs with the 9C chains overlapping each other. In (ii) and (iii) (space group C_2^2) the maleic anhydride ring is perpendicular to or lies in the plane of the rings respectively. The results support Windaus' formula. Comparison of (v), (vi) and (vii) gives no clear information as to the position of the Br atoms.

C. A. S.

962. X-Ray Studies of Crystallite Orientation in Cellulose Fibres. W. A. Sisson. *Indust. and Engin. Chem.* 27. *pp.* 51–56, *Jan.*, 1935.—The *b* axis of the crystallites being that of the cellulose chains and either parallel or inclined spirally at a definite angle, *φ*, to the length of the fibre, with a view to determining whether the *a* and *c* axes are definitely orientated or not, the X-ray appearances and intensity distributions to be expected for various assumed arrangements (or absence thereof) and

various values of ϕ have been worked out, and tested by comparison with those given by artificial cellulose sheets of known orientation or definitely arranged bundles of fibres. It is concluded that the crystallites have an unlimited rotation around the *b* axis in the face of the cell wall, probably explicable by the assumption of a definite discontinuity of crystal structure.
C. A. S.

963. Structure of Dinitrocelluloses. M. Mathieu. *Comptes Rendus,* 200. *pp.* 143–145, *Jan.* 7, 1935.—Nitroramie containing 10·5–12·9 % N gives the diagram of dinitrocellulose with very little variation with content of N within those limits; but with higher percentages of N spots characteristic of trinitrocellulose appear, and these alone remain when N is $>$ 13·3 %. The appearances imply that in the di- (or less) nitro products the NO_2 groups are distributed at random along the molecular chains, but in the planes of the glucose ring, causing (when N is $\not>$ 13 %) a separation of the chains by distances up to 13·86 Å, which is close to the dimension of the NO_2 group as deduced from the atomic dimensions of N and O. The network of nitro-cellulose with $<$ 13 % N has *a* 13·86, *c* 8·0 Å, β 90°. No definite value for *b* (the fibre axis) is determinable owing to the irregular distribution of the NO_2 groups, but there are pseudo-periods of 5·2 Å representing the diameter of the glucose rings, and of 3·5 Å, probably the distance between the O atoms of the NO_2 groups. [See Abstract 1267 (1933).] C. A. S.

964. Crystal Orientation in Tooth Enamel. J. Thewlis. *Phil. Mag.* 19. *pp.* 291–297, *Feb.,* 1935.—From X-ray diffraction photographs of tooth sections it is shown that tooth enamel is composed of preferentially oriented apatite crystallites, with the [001] direction as fibre-axis. In the case of dogs' teeth the fibre-axis is normal to the enamel surface. In human teeth there are two possible positions for the fibre-axis, inclined to the normal at 20° and − 10° respectively. J. T.

965. Thermal Study of Liquid Crystal Formation. E. L. Skau and H. F. Meier. *Faraday Soc., Trans.* 31. *pp.* 478–480, *Feb.,* 1935.—Observations of the heat changes at the transitions, solid → liquid-crystalline and liquid-crystalline → isotropic liquid. For para-methoxy-cinnamic acid, the latent heats calculated are in the ratio of 7 : 1.
A. S. C. L.

966. Influence of Light on the Formation or Destruction of Colloidal Sodium in Rock-Salt. S. Arzybyšev, L. Milkovskaja and M. Savostjanova. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 382–389, *Dec.* 1, 1934. *In German.*—It is possible to prepare NaCl crystals by electrolytic treatment, showing U centre absorption (ultra-violet) F centre absorption (yellow with absorption maximum at 465 $\mu\mu$) and K centres (colloidal Na). From a coloured crystal 2 plates were cut, one was exposed to the Al spark and the other not. After heating both to 380° C. both became violet, but the one exposed to the light had an absorption four times that of the unexposed. A table of results is given which is alleged to show that the K and F centres act as nuclei for the colloidal condensation of U centres on heating. On the other hand it is found that destruction of the colloidal aggregates occurs with formation of K and F centres on exposure of a colloidally coloured crystal to the Al spark. J. E.

967. Elastic Behaviour of Single and Multiple Crystals of Tin. W. Boas. *Helv. Phys. Acta,* 7. 8. *pp.* 878–883, 1935. *In German.*—The dependence on orientation of the moduli of elasticity and torsion of the crystal of tin is described. The method employed is that given by Huber and Schmid [see Abstract 4025 (1934)]. By formation of average value over the whole region of orientation the moduli of the quasi-isotropic multiple crystal are calculated, and comparison is made with experiment.

J. J. S.

See also Abstracts 975, 1102, 1116, 1118, 1177, 1185, 1212, 1219, 1249, 1254, 1263, 1267.

DENSITY.

See Abstracts 977, 1061.

DIFFUSION AND OSMOSIS.

968. Permeability of Refractory Materials to Gases. E. Preston. *Soc. Glass Technol., J.* 18. *pp.* 336–373 ; *Disc.*, 374–390, *Dec.*, 1934.—The problem of permeability is examined in a critical manner, the significance of permeability measurements discussed, and methods of determining it examined. The assumptions involved in the calculation of permeability are reviewed, and the necessity stressed of recording the volume of gas passing through the sample as the volume at the mean absolute pressure of the test. A definition of permeability which takes account of this fact is proposed. Data are quoted on the relation of permeability to refractory type, and to the method of manufacture. The temperature-permeability relationships are discussed on the basis of a fundamental concept of permeability, and the influence on permeability of firing temperature, the amount and kind of grog in the refractory, and of the amount of bond present. Various avenues of research are indicated throughout the paper.

AUTHOR.

ELASTICITY AND PLASTICITY.

969. Flexure Problem for Rectangular Beams with Slits. D. F. Gunder. *Physics*, 6. *pp.* 38–42, *Jan.*, 1935.—Experimental and approximate theoretical studies, made at the United States Forest Products Laboratory, Madison, Wisconsin, show that the mean shearing stress in the neutral plane of a rectangular beam with symmetrical horizontal slits or checks extending along its lateral faces is less than that given by the usual engineering formulæ ; that is, there is a definite " two-beam " action which relieves the shearing stress in the portion of the beam weakened by the slits. This paper presents an exact solution of the flexure problem for a beam of such section and confirms the main features of the distribution of shearing stress found in the earlier investigation. The solution of the flexure problem requires the solution of Laplace's equation within the plane region coincident with a cross-section of the beam, subject to certain boundary conditions. This solution is obtained by using the Schwartz-Christoffel transformation of a polygon on to a half-plane and solving the transformed boundary value problem. The exact solution is set up as an infinite series. To simplify the calculations two approximate solutions are also obtained, one of which is used in treating a numerical example.

AUTHOR.

970. Stability of Grooved Plates. A. Weinstein. *Comptes Rendus*, 200. *pp.* 107–109, *Jan.* 7, 1935.—Reference is made to the result obtained by G. I. Taylor in which instability occurs for the buckling load on a rectangular plate with four clamped edges when λ, or $(4Pa^2/D\pi^2) > 5\cdot 30$ [see Abstract 2733 (1933)]. Reasoning based on the general methods of the calculus of variations leads the author to a lower limiting value, 5·1. R. S. R.

971. Stresses in a Plate Containing an Infinite Row of Holes. R. C. J. Howland. *Roy. Soc., Proc.* 148*A*. *pp*. 471–491, *Feb*. 1, 1935.—Harmonic and biharmonic functions are defined having infinities at the points $x = \pm pb$, $y = 0$, p being any integer or zero. The functions are analytic in the rest of the plane and are periodic in x with period b. Expansions are found in terms of polar coordinates (ν, θ) with the origin as pole. A stress function, defined by a series of such functions, may be made to satisfy given boundary conditions on the circle $\nu = a$ ($a < b$) and will then satisfy identical conditions on all the circles of radius a with their centres at ($\pm pb$, 0). The boundary conditions lead to an infinite set of linear equations which are solved by a method of successive approximation, which is proved to be convergent if $a/b < 0{\cdot}27$. The method is applied to find the distribution of stress in a plate perforated by a row of holes when a tension is applied either parallel or perpendicular to the line of centres. In the former case, the holes are found to shield each other, and the maximum stress is reduced. When $a/b = 0{\cdot}25$, so that the holes occupy half the line of centres, the greatest stress is only 2·16 T, T being the tension at infinity, compared with 3T for an isolated hole. For the perpendicular case, the maximum stress is greater than for an isolated hole, the value being 3·24 T when $a/b = 0{\cdot}25$. H. H. Ho.

972. Theoretically Interesting Aspects of High-Pressure Phenomena. P. W. Bridgman. *Rev. Modern Physics*, 7. *pp*. 1–33, *Jan*., 1935.—The author discusses those aspects of the properties of matter at high pressures which can be interpreted, to some extent, in terms of recent wave-mechanics pictures of atomic behaviour and interaction. The subjects discussed include: atomic changes under pressure; volume changes and the "law of force"; thermal expansion and entropy at infinite pressure; p, v, t relations in liquids; periodic relations; compressibility of single crystals; two phase equilibrium; irreversible transitions; discontinuities; electrical resistance; thermoelectric phenomena; thermal conduction; viscosity of liquids; rupture; speculations. J. S. G. T.

973. P.V.T. Relations for Six Oils. R. B. Dow. *Washington Acad. Sci., J.* 24. *pp*. 516–526, *Dec*. 15, 1934.—This work is concerned with the application to oils of high hydrostatic pressures at more than one temperature in order to make a complete thermodynamic analysis. The relative volumes at three temperatures are recorded at pressures up to those approaching the apparent solidifying pressures for six oils of different composition. The present investigation is being continued for some of the individual cuts obtained by the fractionation of one of the mineral oils employed. J. K.

974. Mechanical Properties of Glasses. L. Longchambon. *Comptes Rendus*, 199. *pp*. 1381–1383, *Dec*. 10, 1934.—A steel ball was let fall on the horizontal surface of a glass specimen embedded in concrete. Contact takes place over a circle the area of which depends on the height of fall. The deformations of ball and plane are almost perfectly elastic, and for a fall of 50 cm. the ball rebounds 47 cm. For a certain height of fall, the rupture of the glass extends over the circle of contact. Photographs of the circular marks are given. When the height of fall is increased sufficiently, a peculiar fracture is produced. When the deformation is slight, interference colours appear which may disappear in a few days. A table is given of the masses of the balls, their diameters, the heights of fall and the kinetic energies per mm.^{2} of the area subjected to the collision. The last of these quantities is roughly constant for four balls varying from 30 to 5 cm. dia. G. E. A.

975. Hardness and Lattice-Distortion of Cold-Rolled α-Brass. W. A. Wood. *Phil. Mag.* 19. *pp.* 219–230, *Feb.*, 1935.—The differences in the X-ray spectra of samples of α-brass hardened to different degrees by cold-rolling are determined. Particular attention is paid to the increase in breadth of the diffraction lines. The increase in breadth is found to be proportional to the increase in hardness of the brass, and a relation between the two quantities is suggested. The broadening of the lines is attributed to lattice-distortion as a result of measurements which show that the unit-cell of the brass ceases to be cubic after the material has been cold-worked. AUTHOR.

976. Effect of Direction of Drawing upon the Breaking Strength of Drawn Plate Glass. W. Mangler. *Zeits. f. Physik*, 93. 3–4. *pp.* 173–176, *Jan.* 4, 1935.—Experiments carried out upon ground and polished rods made from drawn plate glass show that the mean " mirror " area [see Abstract 4846 (1934)] and the mean breaking strength are different for rods cut respectively parallel and normal to the direction of drawing. L. A. W.

***977. Apparatus for Measurement of Compressibility of Gases. J. A. Beattie.** *Am. Acad., Proc.* 69. *pp.* 389–405, *Nov.*, 1934.—A detailed description is given of apparatus and experimental methods for measuring the compressibilities of gases over a pressure range of from 10 to 500 atmospheres and at temperatures ranging from the freezing point of mercury under pressure to 325° C. Temperatures and volumes are accurately measured and controlled, and the pressure and mass of gas is also determined. The ultimate uncertainty in the compressibility data is estimated as 0·03 % at the lower and 0·2 % at the higher temperatures and pressures. R. W. P.

***978. Piezoelectric Manometer and Vibration Recorder. A. Langevin.** *R.G.E.* 37. *pp.* 3–10, *Jan.* 5, 1935.—The pressure is applied directly, or through a mechanism, to a quartz plate provided with electrodes connected to the grid and filament of a valve. Variations of pressure cause the liberation of electricity at the electrodes of the quartz plate. The grid-filament potential varies, and the resulting changes in the p.d. across a high resistance in the plate circuit after amplification in resistance coupled stages, are applied to an oscillograph. Faithful reproduction of rapid changes is secured by using a valve of special construction, called triode-electrometer, which has a much higher vacuum and a much higher grid-filament insulation than ordinary valves. A variable condenser shunted across the quartz plate provides a flexible and convenient means of adjusting the sensitivity. Applications include the recording of the variation of pressure in pipes connected to hydraulic rams, in the veins and arteries of the human body, and in the cylinders of internal combustion engines ; of the stress exerted on rails by locomotives, of the acceleration of vehicles, and of the vibration of structures. P. V.

***979. Interference Extensometer and the Elasticity of Lead. B. Chalmers.** *Phys. Soc., Proc.* 47. *pp.* 352–370, *March*, 1935.—A description is given of an extensometer in which interference fringes are used to measure elastic and plastic extensions of specimens of length about 3 cm. to an accuracy of about 3×10^{-7} cm. Experiments on specimens of lead are described, and the following are the principal results obtained. (i) A specimen that has not recently been severely strained has a definite range in which Hooke's law is obeyed within experimental limits, and a definite elastic limit. (ii) When the specimen has recently been severely strained, a new type of closed elastic-hysteresis loop is obtained. (iii) The elastic after-effect was investigated, and it was found that when the stress is below the elastic limit, the whole of the observed effect can be accounted for thermodynamically. (iv) The true plastic after-effect (creep) was found to commence when the elastic limit is exceeded. AUTHOR.

See also Abstracts 994, 1057, 1070, 1074, 1075, 1207, 1208.

GRAVITATION.

980. Variation in the Attraction of a Spherical Zone. S. Ballarin. *Com. Geod. e Geofis., Boll.* 4. *pp.* 107–113, *Oct.,* 1934.—The paper derives a rapid and sufficiently exact formula for the determination at a point in a sphere of the normal component of the Newtonian attraction exercised by a spherical zone, when the analogous component in the case of a sphere, with radius only slightly different, is known. W. A. R.

981. Fundamental Tables for the Reduction of Gravity. Part II. Use of the Tables. G. Cassinis and P. Dore. *Com. Geod. e Geofis., Boll.* 4. *pp.* 97–106, *Oct.,* 1934.—The tables are here applied directly to particular cases in order to find the reduction. Sets of tables may be also derived from the original tables which are very convenient in making these reductions. One of the principal advantages of the method consists in assuming a presumably more constant density for each part instead of taking a mean density over a large area. For construction of the tables see Part I, Abstract 4852 (1934). H. M. B.

982. Differential Method for the Measurement of Gravity. B. Gulotta. *Com. Geod. e. Geofis., Boll.* 4. *pp.* 114–129, *Oct.,* 1934.—The advantages and disadvantages of the differential method are discussed. The influence of the length of the pendulum on the results of observations made by the classical method is compared with that on the results of the differential method. The effect of different pendulums in the free air method is investigated. W. A. R.

HYDRODYNAMICS AND AERODYNAMICS.

983. Current Impinging on a Moving Object. A. Consiglio. *Accad. Lincei, Atti,* 20. *pp.* 310–314, *Nov.* 4, 1934.—General formulæ are derived for the calculation of the dynamic effects exercised upon a moving obstacle by a plane current, not stationary at infinity. [See following Abstract.] W. A. R.

984. Moving Ellipsoidal Object Surrounded by a Plane Non-Rotating Current. A. Consiglio. *Accad. Lincei, Atti,* 20. *pp.* 315–321, *Nov.* 4, 1934.—The special case of a plane non-rotating current impinging on an ellipsoidal object, rotating about its centre, has already been considered [see Abstract 3528 (1932)]. The calculation is now extended to the more general case where the rotating body is moving in any manner in the plane of the current, which is no longer regarded as necessarily stationary at infinity. [See preceding Abstract]. W. A. R.

985. Linear Elements Generated by the Motion of Fluids. C. Camichel and L. Escande. *Comptes Rendus,* 199. *pp.* 1555–1557, *Dec.* 26, 1934.—Experiments by Crausse and Baubiac [see Abstract 2193

(1933)] on the regions of transition have suggested a study of the linear elements generated by the motion of fluids. As well as the purely geometrical dimensions of the system, the motion of the fluid makes other linear elements appear. These are examined and are called linear hydraulic elements. The cases of ideal and viscous fluids are discussed, the dimensions of the linear hydraulic elements being functions of the Reynolds number. Applications are made to the wake of a cylinder and to surfaces of discontinuity. G. F. P. T.

See also Abstract 1069.

KINETIC THEORY OF MATTER.

986. Diffraction Intensities of Molecular Rays at Rigid Crystal Surfaces. W. Lenz. *Zeits. f. Physik*, 92. 9–10. *pp*. 631–639, *Dec*. 7, 1934.—To simplify the problem of the scattering of molecular rays at the surfaces of crystals the scattering at a rigid periodically undulatory surface is considered. The rigorous method due to Rayleigh, which easily becomes laborious, is replaced by two approximation methods, one based on geometrical optics, which is here only sketched, and another depending on Huygens' principle, in which the behaviour of the wave at the surface itself is described, the wave being regarded as the superposition of the incident and the regularly reflected wave at the point in question. A comparison with the result obtained by Rayleigh's method in a special case, shows that the method is useful without becoming cumbersome [See following Abstract.] H. L. B.

987. Diffraction Intensities of Molecular Rays at Rigid Crystal Surfaces. E. Brandt. *Zeits. f. Physik*, 92. 9–10. *pp*. 640–660, *Dec*. 7, 1934.—The method of geometrical optics sketched by W. Lenz [see preceding Abstract] is worked out and compared with the wave-optical method worked out by Rayleigh for the special case of lattice surfaces of semi-wave form. Rayleigh's method is completed and practical methods of approximation are described. The agreement in the two methods is found to be perfect within the limits specified in the paper. H. L. B.

988. Molecular Rays. V. Guillemin, Jr. *Frank. Inst., J*. 219. *pp*. 73–85, *Jan*., 1935.—The developments in this branch of physics since 1931 are sketched with special emphasis on such points as the scattering in gases, the diffraction on crystal surfaces; the determination of the magnetic and electric moments of atoms and molecules, and the phenomena and theory of the " double Stern-Gerlach experiment." G. C. McV.

See also Abstracts 1140, 1206.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***989. Stabilised Ultramicrometer. N. Marinesco.** *Comptes Rendus*, 200. *pp*. 118–120, *Jan*. 7, 1935.—Describes a development of the ultramicrometer in which the two h.f. oscillators are stabilised, the first being controlled by a quartz crystal, the second being variable. The two oscillators set up beats in a common aperiodic circuit. The variations in length to be measured cause changes in the thickness of a parallel-plate condenser connected in parallel with the capacity in the second oscillator circuit, the movements being transmitted by a linear system employing the beam of a precision balance. The instrument is sensitive to about 1 × 10^{-7} cm., and is capable of showing the growth of plants during a few seconds, or of detecting variations in temperature of about 0·0001° C. in a fine wire. With slight modification it is stated that the arrangement might be used to give automatic warning of fire-damp. H. B.

See also Abstract 979.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

***990. Automatic Equalisation and Recording Arrangement for Variable Forces. T. Jurriaanse and J. A. van Lammeren.** *Zeits. f. techn. Physik,* 16. 1. *pp.* 18–19, *Jan.,* 1935.—The force to be measured is applied to one arm of a balance and its moment balanced by that between two coils, attached to the other arm, and through which an electric current flows. The current forms a measure of the applied force. Displacement of the zero of the balance rotates an attached mirror reflecting light to the photoelectric cell and an equalisation current through the coils is set up in an electrical network. The essential requirements of the apparatus regarding constancy of the photoelectric cell, and the aperiodic motion and small moment of inertia of the balance are given. R. S. R.

***991. Devices Ensuring Constancy of Mass of Precision Weights. J. J. Manley.** *Phil. Mag.* 19. *pp.* 243–251, *Feb.,* 1935.—Following up previous work [see Abstract 4362 (1933)] the author puts forward two methods for the storage of precision weights in such a way as to ensure significant constancy of mass. A 100-gm. chromium plated weight was enclosed in an African blackwood box lined round the sides of the weight with chemically clean silk wound on a copper cylinder. In 72 weeks it gained $0{\cdot}0001_0$ mg. per 1 cm.^{2} A set of polished " nichrome " weights was stored in a fully seasoned boxwood box. Each weight was situated in a cell lined as above and having a perforated base. The weight was supported on a flat ivory ring. The cell was in communication via its base with a chamber containing cocoanut charcoal in a tin box sealed with filter paper. The 100 gm. weight gained $0{\cdot}0001_9$ mg. per 1 cm.^{2} in 60 weeks. This method of storage is preferred because the possible emanation of harmful vapours from the wood is guarded against, and also it is less expensive. A plain brass weight which suffered unusual loss on gentle rubbing while cleaning gained an unusual amount on storage, thus showing the necessity for care in the choice of standard weights. P. H. B.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

992. Logical Integration of Dynamical Equations with Two Variables : Conservative Forces : Cubic Integrals : Movements of the Plane. J. Drach. *Comptes Rendus,* 200. *pp.* 22–26, *Jan.* 2, 1935.—The resolution of the problem in dynamics with two degrees of freedom for a conservative system requires the integration, for any value of h, of the equation $f = pq/\lambda - \mathrm{U} = h$, where λ and U are functions of x and y, and p and q are derivatives of z. The general cases for integration are considered and applied to cubic integrals and the motion of the plane. R. S. R.

***993. Electric Calculator. R. Sewig.** *Zeits. f. Instrumentenk,* 55. *pp.* 34–36, *Jan.,* 1935.—Describes simple electrical circuits for the evaluation of $f(uv)$ and $f(u/v)$. In one circuit a double potentiometer is employed, as shown in Fig. 1. If between u and w there are α divisions, and between x and z are β divisions, the p.d. between x and z is $10^{-4}\mathrm{V}_0\alpha\beta$, assuming

100 divisions on each scale, and calling V_0 the potential across the first potentiometer. Thus the product $\alpha\beta$ may be read on the galvanometer G. For determining quotients, the circuit of Fig. 2 is used, comprising a resistance *xy* and a potential divider *uv*. The galvanometer current is given by $V_0\alpha/\beta$, where α is *uw* and β is *xz*. The limitations of these instruments are discussed, and more elaborate circuits making use of wattmeters are also given. G. E. B.

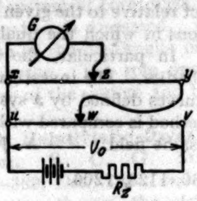

FIG. 1.

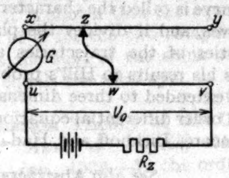

FIG. 2.

See also Abstracts 1058, 1070, 1127.

MECHANICS, CLASSICAL.

994. Stress Systems in an Infinite Sector. W. M. Shepherd. *Roy. Soc., Proc.* 148A. *pp.* 284–303, *Feb.* 1, 1935.—The solution of the problem of generalised plane stress corresponding to a plate in the form of an infinite sector, acted upon by an isolated force in its plane at the vertex, balanced by tractions at an infinite distance, has been given by Michell (Proc. London Math. Soc., 34, *p.* 210, 1902). In this paper, the solution is obtained for the case when the force acts at a point of one of the straight edges. The method adopted is similar to that used by Coker and Filon in solving the problems of isolated forces acting upon an infinite strip, Parts I, II, III and IV respectively consider: the sector under two equal inward normal forces at corresponding points of the two edges; under two equal normal forces, one inward and one outward; under two equal tangential forces, both towards the vertex; under two equal tangential forces, one towards the vertex and one away from it. Part V deals with the displacements; Part VI with methods of calculation; Part VII with the infinite quadrant having two inward normal forces at corresponding points of the two edges, and Part VIII with the infinite quadrant having one normal force applied to an edge. The paper is replete with diagrams and data. H. H. Ho.

995. Spheroidal Pendulum. D. Buchanan. *Roy. Soc. Canada, Trans.* 28. *Sect.* 111. *pp.* 81–95, *May,* 1934.—The problem considered is to determine certain orbits described by a particle constrained to move, under the action of gravity, on a prolate or an oblate spheroid, whose axis is vertical. The solutions for the orbits are obtained as power series in a parameter, the coefficients of which are sums of trigonometric functions of the time. A. J. McC.

996. Curves Defined by a System of Differential Equations of the Second Order, with Applications to Dynamics. N. Moisseiev. *Accad. Lincei, Atti,* 20. *pp.* 178–182, *Sept.,* and *pp.* 256–265, *Oct.,* 1934.—The author first considers the trajectories of a point moving in a plane under a conservative force system, the motion being referred to a rotating system of axes. He then defines a certain curve in the plane as the locus of points where the contact of the dynamical trajectory with a member of a given family of curves, $f(x, y) = \text{const.}$, is of the second order at least. This curve is called the characteristic of contact relative to the given family of curves, and it divides the plane into regions in which the qualitative properties of the trajectories are different. In particular, the author applies his results to Hill's problem of three bodies. The investigation is finally extended to three dimensions and to curves defined by a system of second order differential equations, and the method is compared with those of Poincaré, Birkhoff and Hadamard in the same field. A. J. McC.

See also Abstracts 990, 992, 1030, 1128, 1206.

MECHANICS, QUANTUM.

997. Relation Between Vector and Bond Eigenfunction Methods for Spin Degeneracy. R. S. Bear and H. Eyring. *J. Chem. Phys.* 3. *pp.* 98–106, *Feb.*, 1935.—A method previously developed for the calculation of matrix components for problems in which spin degeneracy only is important is shown to be equivalent to an operator method derivable from the vector approach of Dirac. Complete rules for the simple construction of matrices for all possible cases which can arise under these conditions of spin degeneracy are given. An especially simple way of determining secular equations for states of the identical representation is described, and the method is applied to the calculation of the energy of an infinite linear extension of sodium atoms. An inspection method of resolving a crossed six bond eigenfunction in terms of the uncrossed set is given. AUTHORS.

998. Relativistic Quantum Electrodynamics and Emission of Radiation in Collisions of Very Fast Electrons. G. Wataghin. *Zeits. f. Physik*, 92. 7–8. *pp.* 547–560, *Nov.* 30, 1934. *N. Cimento*, 11. *pp.* 635–647, *Nov.*, 1934.—By modifying in a special manner the term representing interaction energy in the Hamiltonian for an electron in a radiation field, it is shown that the difficulty of infinite self-energy of the electron may be overcome while retaining a relativistic invariant quantum electrodynamics. The modified electrodynamics is applied to the radiation emission at the impact of an electron and a nucleus and to the production of a pair of electrons by the absorption of a hard light quant ($h\nu > 2mc^2$) by a nucleus. W. S. S.

999. Concept of Force in Wave Mechanics. R. L. Rosenberg. *Phil. Mag.* 18. *pp.* 1150–1158, *Dec.*, 1934.—When a current of particles is scattered by a force-centre (due to the presence of another body, the "scatterer") there is a redistribution of the current of particles throughout space. By finding the rate of change of momentum or the force exerted on the scatterer by the stream of particles the author is led to formulate the idea of force in wave-mechanics and to express it as a force-matrix. The problem is attacked from the point of view of a field-theory, the force-density being defined as the four-dimensional divergence of the energy-momentum tensor of the material field. The treatment is non-relativistic throughout. General formulæ are obtained which are also applicable to the case of electrons in discrete negative energy states. Properties of the force are also discussed in stationary and non-stationary states in which the effect of a perturbation causing transitions is found. H. L. B.

1000. Centre of Gravity in Dirac's Mechanics. Application to Photons, Spin and Protons. J. L. Destouches. *Comptes Rendus,* **199.** *pp.* **1594–1596,** *Dec.* **26, 1934.**—The motion of the centre of gravity (G) of a system of corpuscles, each separately satisfying a Dirac type of wave equation is discussed. In particular it is shown that the equation of motion of the de Broglie photon is that of G for the two components of the photon. The spin operator of G is the sum of the spins of the corpuscles of the system and the spin of G equals the total spin.

J. S. G. T.

1001. Relativistic Invariant Perturbation Theory of the Dirac Electron. E. C. G. Stueckelberg. *Ann. d. Physik,* **21. 4.** *pp.* **367–389,** *Dec.,* **1934,** *and* **21. 7.** *p.* **744,** *Jan.,* **1935.**—In the ordinary perturbation theory, the eigenfunctions of the perturbed system are developed in terms of the eigenfunctions of the unperturbed system using time variable coefficients. By expanding these coefficients in a Fourier series with respect to the time, the results are obtained in a relativistic invariant form. This method is applied to the scattering of radiation by a moving electron (generalised Klein-Nishina formula) and to the emission of radiation by the collision of electrons with nuclei.

W. S. S.

1002. Wave Equation in Relative Motion. G. Petiau. *Comptes Rendus,* **200.** *pp.* **111–113,** *Jan.* **7, 1935.**—The transformation of the equation of propagation satisfied by the function attached to the motion of a particle in a potential field is found for the case in which the coordinates of the moving point are not related to an absolute system of axes, but to axes themselves subject to any motion. N. M. B.

1003. Charge and Field Fluctuations. J. R. Oppenheimer. *Phys. Rev.* **47.** *pp.* **144–145,** *Jan.* **15, 1935.**—The field fluctuations which arise from the possibility of creating positron-electron pairs are computed. These fluctuations, which are inescapable in all field measurements, give a simple interpretation of Heisenberg's results on charge fluctuations, and of the divergences which appear in his calculations. The pair-induced fluctuations in the radiation field are in general small of order α compared to those which arise from the corpuscular character of the radiation.

AUTHOR.

1004. Production of Pairs by Charged Particles. J. R. Oppenheimer. *Phys. Rev.* **47.** *pp.* **146–147,** *Jan.* **15, 1935.**—The internal conversion by pair-production of the radiation emitted in the impact of charged particles is computed. When the energy available for pair-production is large compared to mc^2, this simple method gives a valid estimate of pair-production by the impact. For electrons of very high energy the probability of pair-production increases as $[\ln (E/mc^2)]^3$. [See Abstract 4871 (1934).] AUTHOR.

1005. Two-Quantum Σ-States of the Hydrogen Molecule. R. D. Present. *J. Chem. Phys.* **3.** *pp.* **122–128,** *Feb.,* **1935.**—A wave function in the form of a series with coefficients to be determined by the variational method is used to calculate the dissociation energies of the hydrogen molecule in two of its excited states: $1s\sigma 2s\sigma\ {}^3\Sigma_g{}^+$ and $1s\sigma 2p\sigma\ {}^1\Sigma_u{}^+$. In the former case an 11-term wave function gives an energy less than 0·02 eV from the most probable experimental value and lying within the limits of experimental error. For the second state an energy less than 0·08 eV from experiment is obtained by means of a function comprising 18 terms. The interelectronic distance has been introduced explicitly into the wave function and the rôle that it plays in reducing the energy is discussed at length. The limits of accuracy of the calculation with reference to convergence and nuclear motion are considered. Explicit wave functions are given for the two states. AUTHOR.

See also Abstracts 1009, 1070, 1176, 1198, 1205, 1206, 1215, 1251.

RELATIVITY AND ETHER.

1006. Significance of the Jena Michelson Experiment. L. Baumgardt. *Ann. d. Physik*, 21. 6. *pp.* 573–576, *Jan.*, 1935.—The refraction of the air in the Michelson-Morley experiment ought to give rise to a displacement of the interference fringes. Although the experiment performed at Jena was accurate enough to reveal them, they were not found. G. C. McV.

1007. Displacement of Mercury's Perihelion. G. Maneff. *Comptes Rendus*, 199. *pp.* 1376–1378, *Dec.* 10, 1934.—Le Verrier's value for the displacement of Mercury's perihelion is $38''\cdot 3$. Starting from the linear element of the theory of relativity and using a method given by Hilbert the author obtains the value deduced by Einstein. In order, however, to find a physical parallel to the two mathematical expressions that are identified in the process it is necessary to modify the calculation by allowing for the variation of the time-rate in different parts of the interior of the massive spheres of astronomical bodies. This introduces a numerical correction into the calculations which leads to the value $38''\cdot 2$, one of two values previously found by Grossmann on the basis of calculations made by Newcomb. H. L. B.

1008. Two-Dimensional Electrostatic Solutions of Born's New Field Equations. M. H. L. Pryce. *Cambridge Phil. Soc., Proc.* 31. *pp.* 50–68, *Jan.*, 1935.—The general solution of Born's new field equations [see Abstract 1875 (1934)] is found for the two-dimensional electrostatic case, by which the coordinates are expressed as functions of the field vectors. Conditions for inversion are discussed. Special cases are worked out, namely: single charge, two charges, charge in a constant field. Expressions are given for forces acting on the charges. A singular solution is also discussed, with reference to the neutron. The implication of the solutions on the general theory and the equations of motion is discussed in the conclusion. AUTHOR.

1009. Born-Infeld Field Theory of the Electron. E. Feenberg. *Phys. Rev.* 47. *pp.* 148–157, *Jan.* 15, 1935.—Since the field equations of the Born-Infeld field theory [see Abstract 1875 (1934)] impose no essential restrictions on the world lines of the singularities, a dynamical condition, equivalent to equations of motion, must be added to complete the theory. The variation problem from which Born and Infeld obtain equations of motion by varying the world lines of the singularities does not appear to be susceptible of generalisation to include radiation reaction and, moreover, the equations of motion are not invariant in form under a Lorentz transformation. The definition of a magnetic charge and current vector (which vanishes for an isolated singularity in uniform rectilinear motion) makes possible the derivation from the energy-momentum conservation laws of a relation which is the formal analogue of the dynamical assumption, in the classical theory of electromagnetic mass, that the total force on the electron, including the self-reaction, vanishes. This result is not, however, equivalent to equations of motion because the non-classical part of the field arising from the non-linear character of the field equations always adjusts itself, for arbitrary motion of the singularity, to maintain the relation. In the coordinate system in which the singularity is momentarily at rest the relation simplifies notably and points to a new dynamical condition which appears to be singled out from all other possible conditions by its compelling simplicity. The resulting equations of motion contain the usual radiation resistance term and also higher order terms in the self-interaction. AUTHOR.

1010. New Field Theory. B. Hoffmann. *Roy. Soc., Proc.* 148A. *pp.* 353–364, *Feb.* 1, 1935.—Since, in the determinantal formulation of the Born-Infeld theory [see Abstract 1875 (1934)], it is necessary to assume that the electromagnetic field strengths are the curl of a potential vector, and since a term containing the Riemannian curvature scalar must also be arbitrarily added to the Lagrangian, a generalisation of the Lagrangian in terms of the projective theory of relativity is discussed. This automatically solves the two difficulties above and gives Born's field for the Galilean case. The Galilean case must not be assumed, since the electrostatic field itself exerts a gravitational influence. In the absence of a general spherically-symmetric, static solution of the field equations of the present paper, the degree of modification of the electrostatic potential by its own gravitational field cannot be determined. It is shown that if Born and Infeld's suggestion for including gravitation be adopted, the electrostatic potential is actually unaltered; and the general spherically-symmetric, static solution is obtained for this case. AUTHOR.

1011. New Conception of Physical Space. J. L. Destouches. *Comptes Rendus*, 200. *pp.* 192–195, *Jan.* 14, 1935.—It is sought to construct the notion of physical space without recourse to the macroscopic ideas of rigid bodies and clocks, but only by the use of the idea of a corpuscle. Corpuscles are assumed to be divisible into certain classes (*e.g.*, corpuscles of different masses and charges) and it is assumed that an assembly of corpuscles can be defined. The concept of the neighbourhood of a corpuscle is defined by means of collisions between corpuscles and this neighbourhood is assumed to be finite. The corpuscular space is also assumed to be continuous, topologically homogeneous and to have three dimensions (in a certain sense). The proof that a space defined in this way does give ordinary Euclidean space in a macroscopic sense is left over. G. C. McV.

See also Abstracts 1027, 1028, 1032.

SOLUTION.

See Abstracts 949, 1020, 1180, 1250.

SURFACE TENSION AND COHESION.

1012. Theory of Imbibition. C. E. Guye. *Helv. Phys. Acta*, 7. 8. *pp.* 850–855, 1935. *In French.*—In this paper, which continues previous work [see Abstract 4065 (1934)], the author considers mathematically four cases of propagation, viz.: horizontal, ascending, horizontal with lateral loss, and ascending with lateral loss, where analogies with diffusion can be made. Relations are established whereby numerical values can be assigned to the constants which occur, when the steady state is reached of an equilibrium between the soaking process and the loss by evaporation. H. H. Ho.

1013. Interpolation of Surface Tension of Unassociated Organic Liquids. A. R. Carr and T. Wolczynski. *Am. Chem. Soc., J.* 56. *pp.*

2541–2542, *Dec.*, 1934.—A method of calculating surface tensions of unassociated organic liquids, analogous to Duhring's rule for vapour pressure and based on Ferguson's equation $\gamma = K(T_c - t)^{1.2}$. The method can also be used for obtaining critical temperatures. P. H. B.

*1014. **Surface and Interfacial Tension of Mercury by the Sessile Drop and Drop-Weight Methods. H. Brown.** *Am. Chem. Soc., J.* 56. *pp.* 2564–2568, *Dec.*, 1934.—A new modification of sessile drop apparatus has been used for the determination of the surface and interfacial tension values of mercury. The results obtained with large flat drops and with small ones were found to be in good agreement with those also obtained by the drop-weight method. The following are the main results; (1) for the interfacial tension against water, 374·3 dynes/cm. at 25°; (2) for the surface tension of mercury in dry air and *in vacuo*, the same value within experimental error of about 0·3 %, 473 at 25°. (3) It was shown thermodynamically that the surface tension of mercury *in vacuo* has to be at least as high as 447 at 25°. This eliminates some of the values obtained by previous workers. (4) On the basis that the surface oxidation of mercury in air takes place only in the presence of water vapour, some of the perplexing phenomena often observed with mercury can be explained, such as irreversible adsorption effects, and the difference in results some times obtained with a static and a dynamic method. AUTHOR.

See also Abstracts 935, 1243.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 1119.

VACUA, HIGH.

*1015. **High-Speed Oil Diffusion Pump. R. M. Zabel.** *Rev. Sci. Instruments*, 6. *pp.* 54–55, *Feb.*, 1935.—The pump is of the jet type and constructed of glass. Two forms are described, one having four jets and the other having seven. Dimensioned drawings of each pump are given. The four jet pump has a speed of 40 l. per sec. at 5×10^{-5} mm. of mercury, and requires 200 W. for heating, while the seven jet pump has a speed of 76 l. per sec. at 5×10^{-5} mm. of mercury and requires 300 W. The backing pressure in each case is 0·02 mm. of mercury. It is stated that the pumps operate on Apiezon oil B or on butyl phthalate.

G. E. B.

*1016. **Rotating Vacuum Gauge with Three Measuring Ranges from 700 to 0·0001 mm. Hg. H. Moser.** *Phys. Zeits.* 36. *pp.* 1–2, *Jan.* 1, 1935. *From the Reichsanstalt.*—The instrument, constructed of glass is essentially of the McLeod gauge type. The system may be rotated about an axis perpendicular to the plane of the gauge. The three ranges are obtained by rotating the gauge until a certain pair of tubes is vertical. With the wide tubes vertical a high-pressure gauge is obtained, while with the capillary vertical the lowest pressures may be read. G. E. B.

*1017. **Torsion Balance as Micro-Manometer. H. Reichardt.** *Zeits. f. Instrumentenk.* 55. *pp.* 23–33, *Jan.*, 1935.—The instrument is of the piston type, the piston having a small sideways play in the cylinder. The piston is attached to the lever of a torsion balance, and providing the torsion thread is sufficiently fine, the sensitivity of the manometer surpasses that of a liquid manometer. By suitable arrangement, the instrument can be used as a flow manometer. G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

1018. Viscosity of Tetrachlorides of Elements of the Fourth Group. G. P. Lutschinsky. *Zeits. f. phys. Chem.* 171. *Abt. A.* 5–6. *pp.* 348–352, 1934.—The viscosities of the CCl_4, $SiCl_4$, $TiCl_4$ and $SnCl_4$ are shown to obey Batschinsky's formula, *viz.*, $\eta = c/(v - \omega)$ when v denotes the specific volume, ω is a coefficient which decreases with increase of atomic weight of the respective elements. ωM, where M denotes molecular weight of the fluid is proportional to the linear dimensions of the molecules. J. S. G. T.

1019. Conversion of Kinematic Viscosity to Universal Saybolt Seconds (for Petroleum Products). W. B. McCluer and M. R. Fenske. *Indust. and Engin. Chem.* 27. *pp.* 82–86, *Jan.*, 1935.—Examination at 100° and 210° F. of 100 oils covering a wide range of viscosities showed that the relation between Saybolt (S) and kinematic viscosities (η/ρ) cannot be accurately expressed, as has been suggested, in the form: $\eta/\rho = AS + B/S$, where A and B are constants. No general formula is suggested but above 5000 Saybolt sec. (1061 centistokes), $\eta/\rho = 0{\cdot}002042\ S + 0{\cdot}40$. Conversion tables up to 10,000 Saybolt sec. are given. L. V. C.

1020. Law of Mixtures for the Viscosity of Aqueous Solutions of Strong Electrolytes. H. Tollert. *Zeits. f. phys. Chem.* 172. *Abt.A.* 2. *pp.* 129–142, 1935.—The viscosities of eight mixtures of aqueous solutions of strong electrolytes have been measured at 20° C. at two different concentrations (0·1 and 1*N*). The concentration of the mixture was made equal to the sum of the concentrations of the components by preparing a mixture of solutions of, for example, KCl, NaCl, and KCl + NaCl. All the mixtures examined, and also those reported in the literature, obey a law of mixtures if a constant for each system is determined empirically. At limiting dilution this law of mixtures merges into Falkenhagen's viscosity law. The solubility of K_2SO_4 in *N* HCl at 20° C. is 16·08 % by weight on the solution and that of $KHSO_4$ in *N* KCl 28·16 %. The specific viscosities of the ions in 0·1*N* solutions, calculated with the help of the heat of neutralisation (HCl + NaOH), are: OH^- 0·0155, H^+ 0·0047, F^- 0·0162, Cl^- 0·0019, Br^- 0·0020, I^- 0·0061, SO_4^{2-} 0·0135, Li^+ 0·0087, Na^+ 0·0060, K^+ – 0·0030, Rb^+ – 0·0056, Cs^+ – 0·0075, eka Cs^+ – 0·0100, NH_4^+ – 0·0020 and Al^{3+} – 0·0241. Similarly the alteration in the hydrolysis by addition of a neutral salt was determined for $AlCl_3$ + KCl; for 0·07*N* $AlCl_3$, this alteration was 11 % by 0·1*N* KCl, and for *N* $AlCl_3$ 5 % by *N* KCl. T. H. P.

See also Abstract 935.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***1021. Applications of the Heliometer to Astronomical Photometry. R. Tremblot.** *Comptes Rendus,* 199. *pp.* 1294–1295, *Dec.* 3, 1934. In order to determine the difference of magnitude of two stars close together on the celestial sphere the heliometer is adjusted so that the stars appear to come from the two halves of the objective ; two semi-circular areas are then perceived by the eye, which are uniformly illuminated by the two sources to be compared. By placing a calibrated wedge in the focal plane of the path of the brighter source (the images must first be slightly separated) and adjusting the intensity by means of a compensating wedge it is possible to obtain uniformity of illumination of the field and hence calculate the relative magnitudes of the stars. A method is also described for converting the instrument into one which may be used for photographic photometry. H. L. B.

***1022. New Transit Instrument. A. Danjon.** *Comptes Rendus,* 199. *pp.* 1580–1582, *Dec.* 26, 1934.—The ordinary transit instrument is itself of a precision inferior to that by which the star transit is determined. The new type of apparatus is not defined geometrically but optically. If a plane mirror is oriented to the meridian of the place, the star and its image coincides and an observing telescope furnished with an impersonal micrometer determines the time of coincidence. A second telescope, fixed, furnished with a micrometer having two wires at right angles and whose axis is normal to the meridian, serves to determine by auto-collimation the direction of the plane of the mirror, and to refer it to terrestrial guiding marks, say the vertical by means of a mercury ball, or the azimuth by means of a distant sight. A diagram is given of such an instrument installed some months previously at the Strasbourg Observatory. A. S. D. M.

***1023. Giant Telescopes. H. S. Jones.** *Journ. Sci. Instruments,* 12. *pp.* 37–43, *Feb.,* 1935.—The development of large telescopes is briefly reviewed, from the refractors with simple lenses and reflectors with mirrors of speculum metals, to the achromatic lens and the silver on glass mirror, which is now being superseded by pyrex glass and aluminium coating. Improved methods of figuring and of mounting are also noted. Already a 300-in. mirror has been designed at Mt. Wilson, and Ritchey is constructing for the Naval Observatory a mirror of the entirely new Ritchey-Chrétien figure. M. A. E.

See also Abstract 1035.

COMETS AND METEORS.

1024. Hyperbolic Orbits. C. H. Smiley and M. Davidson. *Roy. Astron. Soc., M.N.* 95. *pp.* 63–67, *Nov.,* 1934.—The paper discusses the method of obtaining the coefficients of additional terms in Davidson's expansion for the area of a sector in hyperbolic motion [see Abstract 917 (1933)], and also the number of terms required for a sufficiently good determination of the time interval to perihelion. An example suggests that the method is not sufficiently accurate to the number of terms used by Davidson, who points out in a note that the example is beyond one of the limits laid down for the method, 2·5 units distance from the sun. Both paper and note also recommend the adaptation of the Gauss-Marth method for nearly parabolic orbits to machine calculation. T. L. M.

1025. Mean Heliocentric Velocity of Meteors by the Diurnal Variation Method. I. Astapovič. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 260–263, *Nov.* 21, 1934. *In English.*—The method is based upon the theory, advanced by Schiaparelli and developed by C. Hoffmeister, of the variation of the number of meteors. The relative frequency of meteors in relation to their heliocentric velocity is given by Hoffmeister with the correction for the effect of zenithal attraction. Observations for the time from April to December 1925 (1594 meteors during 148.4 hours of observation) made in Nikolaev ($\phi = +46°58'$, $\lambda = -2^{h}07.^{m}9$) are reduced, and the value obtained of the mean mass heliocentric velocity of meteors, $c = 1 \cdot 68 \pm 0 \cdot 06$, which is considered to be the lower limit of the velocity of sporadic meteors in view of the effect of twilight and presence of meteors with elliptical orbits. AUTHOR.

See also Abstracts 945, 1029.

COSMOGONY.

1026. Constitution and Development of Rotating Stellar Systems. B. Lindblad. *Roy. Astron. Soc., M.N.* 95. *pp.* 12–24, *Nov.*, 1934.—The author's theory of the formation of flat disc systems [see Abstract 1487 (1934)] forms the basis for further discussion of the origin of spiral structures. It is assumed that the potential of the system is dominated by a large central aggregation. A dynamical investigation assisted by a suitable choice of variables gives some characteristic properties of the motion, which throw light on the asymmetrical drift of large velocities and on differential rotation. Particles which approach the velocity limit, preferably near the " edge " of the system, will be ejected, leading to a contraction of the system. The stream of particles from the mass of stellar motions requires to be accounted for. The nature of perturbations of stars by clusters or clouds is therefore discussed. The clusters and semi-permanent clouds are formed accidentally among stars of nearly common motion. It is shown that high velocity stars will be disturbed mainly in the inner part of their orbits, and tend to run parallel with the galactic plane and along the radius vector, in accordance with observation. An approximate quantitative estimate suggests that the ejection process is now small, was formerly more violent, and influenced the galactic concentration of the stars. The possible effect of " meteoric clouds " is also discussed. Considerations of partial instability lead to the conception of a closed inner formation, particles emerging from which are ejected to much larger distances, leading to the appearance of spiral orbits. T. L. M.

1027. Necessary Condition for the Physical Possibility of Various Types of Universe. P. Drumaux. *Ann. Soc. Sci. de Bruxelles*, 54. *pp.* 224–229, *Dec.* 17, 1934.—The author's earlier argument [see Abstract 4064 (1930)] that the notions of mass and length are inseparable is used to show that most of the proposed universes (Friedmann, de Sitter, Lemâitre, etc.) are impossible. Einstein's spherical static universe, however, conforms to the author's condition. W. S. S.

1028. Expansion or Contraction of a Symmetrical Cloud under the Influence of Gravity. J. L. Synge. *Nat. Acad. Sci., Proc.* 20. *pp.* 635–640, *Dec.*, 1934.—A universe filled with ordered matter, *i.e.* with no chaotic motions, is supposed to obey Einstein's gravitational equations.

The congruence of world lines of the particles filling the universe is assumed to be symmetrical around some given geodesic C. The possible motions of the cloud of particles near that one whose world-line is C are investigated and the conditions for expansion or contraction of the cloud are found. It follows also that the size of the cloud cannot oscillate between fixed values, the radius of the cloud having at most one maximum or one minimum.

G. C. McV.

1029. Condensation Theory of Meteoric Matter and Its Cosmological Significance. B. Lindblad. *Nature*, 135. *pp.* 133–135, *Jan.* 26, 1935.—The theory is put forward that meteoric particles should be formed in interstellar space by a process of condensation owing to the great difference in temperature (some 10,000° Abs.) between the temperature of interstellar gas and that of solid matter in space. This theory satisfactorily explains the cloud of obscuring matter in the galactic plane. It also leads to an explanation of the formation of sun and planets from a gaseous nebula and the formation of satellite systems can also be accounted for. The primordial state of affairs of the sun-planets system is believed to be analogous to that observed in those early-type stars which are surrounded by gaseous envelopes. The ordinary meteorite, however, can only be accounted for on this theory by supposing it to be a fragment of a much larger disrupted body and not a direct product of the condensation process.

G. C. McV.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1030. Mechanical Systems in which Parameters are Functions of Time. H. Mineur. *Comptes Rendus*, 199. *pp.* 1572–1574, *Dec.* 26, 1934.—In the holonomous systems considered, the Hamiltonian is not explicitly dependent on the time but on r parameters which vary as functions of the time. The general solution is intractable in the Lagrangian form. A change of variables is introduced leading to complete integration in two cases (1) adiabatic variation of the parameters; (2) constant energy. Where a complete integral of the Jacobi equation is known, useful results are derivable.

T. L. M.

See also Abstracts 996, 1007, 1024, 1032.

NEBULÆ.

1031. Redward Shift of Spectral Lines of Nebulae. P. I. Wold. *Phys. Rev.* 47. *pp.* 217–219, *Feb.* 1, 1935.—The characteristics of a wave travelling in a medium in which the velocity of light is a function of time is considered and it is shown that the redward shift of spectral lines from distance nebulæ can be accounted for on this basis. For simplicity, the function $c_1 = c(1 - at)$ is assumed and numerical calculations are made yielding a value of $a = 1\cdot81 \times 10^{-17}$ cm. per sec. as being necessary to account for observed redward shift.

AUTHOR.

See also Abstract 1026.

PLANETS.

1032. Einsteinian Correction of the Time in Planetary Motion. G. Garcia. *Accad. Lincei, Atti*, 20. *pp.* 174–178, *Sept.*, 1934.—Continuing the investigations of a previous paper [see Abstract 4461 (1934)] the author determines the corrections to be made in the time of revolution in the Newtonian orbit of a planet in accordance with the relativistic hypothesis.

A. J. McC.

1033. Atmospheres of Planets. H. N. Russell. *Science*, 81. *pp.* 1–9, *Jan.* 4, 1935. *Nature*, 135. *pp.* 219–226, *Jan.* 9, 1935.—Direct telescopic observations indicate the existence of atmospheres on some planets. Spectroscopy shows that water-vapour is present on Mars and CO_2 is abundant on Venus; and recently strong bands in the spectra of the major planets have been recognised as due to methane. Radiometric measurements prove the surface temperature of the large planets to be below −100° C., while the moon's exceeds 100° C. during every rotation. Observation has thus proved that the atmospheres of large planets contain H compounds, those of a size comparable with the earth contain O compounds, and small bodies like Mercury, the moons and asteroids have none. The lesser density of the major planets is now comprehensible, since they are large enough and cold enough to have retained the lighter gases; and although they doubtless have metallic and rocky cores like the earth, they must have very deep oceans of ice, and very extensive atmospheres of methane. The process of development from a gaseous condition in the different cases is described in detail. It is suggested that when the molten earth was solidifying it had an atmosphere largely composed of CO_2, and that a vegetation developed which absorbed the C and set free the O, thus making animal life possible, though some of the O is slowly absorbed by the rocks; that a much later stage is seen in Mars, the ferric rocks giving its surface its red colour; that Venus, probably because of her higher temperature near the sun, has failed to develop life. The clouds on Jupiter are perhaps composed of frozen ammonia crystals, while in Uranus and Neptune the ammonia is completely frozen out, leaving the methane clear to a greater depth. The problem is now nearing solution, thanks to many workers in many branches of science. M. A. E.

1034. Mercury, A Tropic World. W. G. Hale. *Roy. Astron. Soc. Canada, J.* 29. *pp.* 5–14, *Jan.*, 1935.—Antoniadi's article on the planet Mercury [see Abstract 1006 (1934)] suggests a comparison of his map with those of Schiaparelli and Lowell, and all three appear to include the same markings, but seen differently, by Antoniadi as dim, broad shadings, by Schiaparelli in more definite outline, by Lowell as clear sharp lines. Their permanence proves that Mercury turns the same face always to the sun, but as there is a libration of several hundred miles there is a region where heat and cold must alternate; and as Antoniadi has observed clouds there must be some sort of atmosphere and probably water. It is possible, therefore, that life may exist in these border lands, and also in the shadows of the deep ravines which are perhaps indicated by the dark markings on the disc. M. A. E.

See also Abstracts 1007, 1024.

STARS.

***1035. Stellar Photographic Photometry by C. Fabry's Method. H. Grouiller.** *Comptes Rendus*, 199. *pp.* 1583–1585, *Dec.* 26, 1934.—In all photographic-photometric methods, precision is limited because of the deformed images to be measured. In the method described, a small photographic chamber of short focus is placed behind the focal plane of the objective, giving an image of this objective on the plate, and a diaphragm in the focal plane limits this to the region of the sky to be used. Thus there is obtained on the plate a circular disc with a defined border and a very uniform density. The illumination of the plate depends on the square of the focal distances of the telescope and of the little photographic chamber, and objectives of long focus are advantageous. The author describes such an instrument installed on the Equatorial Coudé of the Lyon Observatory (aperture 32 cm., focal length 780 cm.) and gives a curve from 153 observations of the Cepheid, R T Aurigæ (period 3·73 years) whose maximum magnitude is 5·3, and minimum 6·6. In spite of unfavourable conditions the error of an individual measure did not exceed $\pm 0^m\cdot031$, and constitutes the most precise record of the star. A. S. D. M.

1036. Spectrophotometric Criteria of Stellar Luminosity for Faint Members of Hyades Cluster. J. M. Ramberg. *Astron. Iakttagelser och Undersökning, Stockholms, Obs.* 11. 13 [14 *pp.*]. 1934. *In English.*—A continuation of Lindblad and Stenquist's investigation [see Abstract 1898 (1934)] and an application to the non-members superposed on the Hyades and its surroundings so as to gauge the nature of the stellar strata in which they lie [see Abstract 2802 (1934)]. Figures are given of the relation of the colour-equivalent *k* and the break at the *G*-band for the Hyades Cluster which are typical dwarf stars without any peculiarities due to the cluster; of the cyanogen absorption as a function of absolute magnitude, indicating that between limits $6\cdot5 < M_{vis} < 0\cdot85$, Lindblad and Stenquist's figure must be retouched; of the intensity of λ4227, and here the author discusses the differing results obtained by Menzel and by R. K. Young, finding that the line proves a very useful criterion for late-type stars. He thereby judges that stars No. 26 and No. 39 are not members of the cluster but that Nos. 33, 35 and 37 are members, though judged doubtful by van Rhijn and Raimond. Another diagram gives the intensity of λ4227 against quantity *k*. A table gives the final results for the Hyades. A. S. D. M.

1037. Absolute Magnitudes of Be Stars. B. P. Gerasimovič. *Harvard Coll. Obs., Bull. No.* 897. *pp.* 6–9, *Dec.* 1, 1934.—If the formation of nebular bright line envelopes is due to radiative dissipation of stellar atmospheres, Be stars should be brighter than normal B stars; there should be no difference if the bright lines are due to atmospheric rotational instability [see Abstract 1899 (1934)]. The author finds for magnitude the values $\Delta\underline{M}$(Be − B) from: (1) statistical parallaxes, − 1·5; (2) Pleiades, − 1·2; (3) h and χ Persei, − 1·0; (4) Sco-Cen cluster, − 0·7; (5) distribution data, − 1·5 (estimated); and (6) cosmic calcium, − 1·5. He gives statistical parallaxes double weight and derives $\Delta\underline{M} = -1\cdot3$. But since "normal stars" include several undiscovered Be stars, it probably means that the "pure" absorption line B group stars are at least $0^m\cdot2$ fainter, and makes $\Delta\underline{M} = -1\cdot5$. A. S. D. M.

1038. Colour Temperatures of 25 Stars of High Apparent Brightness. S. L. Thorndike. *Harvard Coll. Obs., Bull. No.* 897. *pp.* 1–6, *Dec.* 1, 1934.—The 11-inch Draper refractor of Harvard was used and each plate had two stellar spectra, the second spectrum being of a comparison star on the Greenwich temperature list [see Abstract 2800 (1934)]; corrections were made for atmospheric absorption by the formula, $I_M = I_0 a^{\sec z}$; six wave-lengths between λλ3950 and 4800 were chosen for measurements of intensity; plates uniformly fogged were made use of, but the characteristic curves differ from those unfogged. For the computing of the temperature of one light source from that of a second source, and the intensity ratios between the two at several wave-lengths, the method of gradients (G) was used by $G = F(T_0) - F(T)$. $F(T) = 1\cdot432(T)^{-1} \times [1 - e^{-33100}/T^{-1}]^{-1}$, was evaluated for a large number of values of T and curves drawn. Δm was got for six points in the spectrum and a plot was made against $1/\lambda$ as abscissa; the points usually falling on a straight line whose slope multiplied by 0·921 gave the gradient between the two stars. The revised Greenwich temperature was substituted for T_e. Tables are given of the temperatures of the 25 stars and of the Greenwich comparison stars. One star (B0 κ Cassiopeiae) shows the abnormally low temperature of 12,600°, probably due to redness from selective absorption in space. (The same applies to the comparison star ζ Persei). A. S. D. M.

1039. Stellar Configurations with Degenerate Cores. S. Chandrasekhar. *Observatory*, 37. *pp.* 373–377, *Dec.*, 1934.—The author sets up an exact differential equation to describe the degenerate state. This leads to a very detailed solution of the general problem of different types of stellar structure. It is shown in particular that the life history of a star of large mass must be very different from that of a small star. For the latter a white dwarf stage is natural and initial to extinction; for large stars the white dwarf stage is impossible. T. L. M.

1040. Internal Constitution of White Dwarf Stars. T. Araki. *Zeits. f. Astrophysik*, 9. *pp.* 163–175, *Dec.* 3, 1934.—A two layer model is discussed, consisting of an inner core containing sources of energy and an outer layer in which no energy is liberated. In the core the process of liberation of energy is assumed to follow the law derived by the author [see Abstract 161 (1935)]. Relations are then derived connecting the density, radius, temperature and ratio of gas to total pressure on the one hand, with the mass and total radiation output on the other. A numerical example is given for a simplified case of the law of liberation of energy. T. L. M.

1041. Stellar Dissociation of H_2 Molecule. R. Wildt. *Zeits. f. Astrophysik*, 9. *pp.* 176–184, *Dec.* 3, 1934.—The ratio of the apparent specific heats of H_2 in the process of dissociation departs considerably from the critical value of 4/3. Tables of the ratio and other properties are given for a wide range of conditions. Hence it is possible to discuss the formation of convection currents in atmospheres largely composed of H_2, for surface temperatures from 1500° to 2500°. It is proposed to apply the conclusions to the atmospheric phenomena of Mira-type variable stars. T. L. M.

1042. Eccentricity of Binary Stars of Very Long Period. D. Barbier. *Bull. Astronomique*, 8. 8. *pp.* 437–462, 1933.—Statistical methods aiming at avoidance of selection effects have already been derived by the author [see Abstract 1909 (1934)]. The aim is now to derive methods for stars of which only a small part of the orbit has been observed, and if possible to obtain an estimate of the manner in which the eccentricity varies with the other elements. The method previously suggested by Russell is fully developed and is applied to the material used in the previous paper. Two other methods depend on the distribution of quantities there defined; one of these has few applications to cases unsuitable for the more detailed treatment. The other is shown to present grave practical difficulties, especially as to the inaccuracy of the available parallaxes. Very precise measures of rather widely separated pairs are desirable; photographic observation on Hertzsprung's method would assist the derivation of hypothetical elements. Some of the quantities used are tabulated as an appendix. T. L. M.

1043. New Elements of Eclipsing Binary U Cephei. J. Ellsworth. *Comptes Rendus*, 199. *pp.* 834–836, *Oct.* 29, 1934.—The radial velocity and photometric observations of this system have hitherto shown considerable disagreement, especially as to eccentricity. From 306 observations, 1931–1934, an improved orbit, in rather better agreement, is derived. There is still a discrepancy as to time of minimum. It is shown that a certain degree of limb shading in both components is required and detailed elements are derived on this assumption. T. L. M.

1044. Mass-Luminosity Relationship and Eclipsing Binaries. J. Ellsworth. *Comptes Rendus*, 199. *pp.* 1378–1380, *Dec.* 10, 1934.—In plotting a mass-luminosity curve Eddington used the masses and absolute magnitudes of 15 visual binaries, 5 Cepheids and 13 eclipsing binaries, of which only the principal components were used. The author plots the values of the secondary component of these eclipsing binaries and concludes (1) that if the masses of the two components are less than or at most equal to that of the sun the luminosity of each component is greater than that given by Eddington's relationship, and (2) that it may also happen that the luminosity of the secondary component is greater than that given by Eddington's relationship, if the density or mass of the secondary component is less than half the mass of the principal component. These conclusions apply to those secondaries that do not obey the law. The principal components almost always obey it. H. L. B.

1045. Recent Eclipse of ζ Aurigæ. A. Beer. *Roy. Astron. Soc., M.N.* 95. *pp.* 24–31, *Nov.*, 1934.—The B-type component underwent eclipse for 38½ days from 24th August, 1934. The photometric details are briefly investigated [see following Abstract]. Spectrographic observations show that for at least 10 days after emergence from behind the K5 supergiant component, the light of the B star passes through an extensive Ca^+ chromosphere belonging to the K star. The displacements of the sharp *H* and *K* lines from the positions appropriate to the K star give a rotational value for this chromosphere, about 19 km./sec. for orbit adopted. The conditions of this chromosphere differed at the two observed eclipses of 1932, 1934. T. L. M.

1046. Photometric Observations of ζ Aurigæ. W. M. Smart and H. E. Green. *Roy. Astron. Soc., M.N.* 95. *pp.* 31–33, *Nov.*, 1934.—Photoelectric observations made at Cambridge Observatory during the 1934 eclipse of the B component and for some months previously are tabulated. The decrease of magnitude was 0·448. [See preceding Abstract.] T. L. M.

1047. Spectrum of Nova Herculis. C. Bertaud. *Comptes Rendus*, 199. *pp.* 1585–1586, *Dec.* 26, 1934.—At the Meudon Observatory with a flint prism, a Zeiss objective of 10cm. aperture and 0·80m. focus, and dispersion, between H and K, of 18 Å per mm., the following results were obtained :—an Mg II emission line (λ 4481) was seen Dec. 15, 17 and 18 ; an O II absorption line (λ 4346) on Dec. 15 ; two fine and intense emission lines at λ 4230 (due perhaps to Fe I) on Dec. 15 and 17 (on which date it was as intense as the Mg II line) ; two emission lines at λ 4174 (probably due to ionised iron) barely seen on Dec. 15, were well seen on Dec. 16 and 17 ; two fairly fine absorption lines at λ 3945 between H and K, due to O, on Dec. 16 ; also on Dec. 16 fine absorption lines between H and K due to interstellar Ca, but by Dec. 18 this was seen only in the middle of the K line. By Dec. 20 the spectrum was changed considerably by the appearance of absorption lines, and according with an increase in the Nova's brightness. On Dec. 15, it was equal to β Draconis (3·0) and on the 20th to γ Draconis (2·4). A. S. D. M.

1048. Density of Interstellar Calcium and Sodium. A. S. Eddington. *Roy. Astron. Soc., M.N.* 95. *pp.* 2–11, *Nov.*, 1934.—The dependence of the intensity of an interstellar line on the density of the absorbing atoms is examined. Three ranges are distinguished: first the intensity increases proportionately to density (unsaturated central absorption). The second range, of saturated central absorption, extends from about 10^{-31} to $5 \cdot 10^{-29}$ gm. per c.c., and has not previously been separated; the intensity remains practically constant. Above this, wing absorption sets in and the intensity increases again, ultimately as the square root of the density. The densities of ionised Ca and neutral Na appear to fall near the upper and lower ends of the new middle range; hence the great difference in the two densities does not show in the intensities of the *K* and *D* lines, which are nearly equal. The upper limit of constant intensity is shown to vary with the distance of the stars considered; and Ca^+ seems to fall just above the limit for stars within 1000 to 1500 parsecs, beyond this below the limit. Observational tests are suggested which might fix the position of the *K*, *H*, and *D* lines relative to this range and so determine the space density of the elements more accurately. T. L. M.

See also Abstracts 1021, 1026, 1029.

SUN.

1049. Theory of Diffuse Scattering of Solar Radiation in an Ideally Pure Atmosphere. R. Knepple. *Gerlands Beitr. z. Geophys.* 43. *pp.* 247–257, 1935.—Based on Rayleigh's theory and with certain simplifying assumptions (that the atmosphere is free from dust and consists of homogeneous parallel layers of decreasing densities, and that all secondary radiation and extinction effects are neglected, but not that due to extinction of direct solar radiation), formulæ are deduced for the radiation received from any point in the sky, both for any particular wave-length and for all wave-lengths. From these is deduced the total radiation for definite zones and for the whole sky. [See Abstract 4808 (1933).] C. A. S.

1050. Origin and Maintenance of the Sun's Electric Field. R. Gunn. *Terr. Mag.* 39. *pp.* 265–276, *Dec.*, 1934.—Reference is made to the results obtained in former papers by which the anomalous rotation of the sun was described in terms of an electric field in its atmosphere [see Abstracts 2768 (1930) and 774 (1931)]. Here in a quantitative way expressions are obtained for the conduction and replenishing current densities and a mechanism results which shows that the sun's atmosphere is pervaded by electric fields of the type and magnitude required to account for the observed anomalous solar rotation and the excessive excitation of ions and atoms in the chromosphere. It is shown that the processes of ionisation and recombination of ions and electrons, subjected simultaneously to the impressed electric and magnetic fields, result in a systematic migration of the ions with a transport of charge in a direction opposite to the motion imposed by electric conduction. This motion can replenish the sun's electric charge and maintain a steady magnetic field. The methods of maintaining electrical equilibrium in the reversing layer and chromosphere are explained. The latter accounts for bright line spectra and an effective temperature of the chromosphere ions of 26,000° is given. The deduced magnitude, direction, and distribution of the superposed atmospheric velocity and electric fields agree with earlier observational data. R. S. R.

See also Abstract 1065.

GEOPHYSICS.

GEODESY.

1051. Calculation of Elevation of the Geoid by Means of the Potentials of a Plane Coating. K. Mader. *Gerlands Beitr. z. Geophys.* 43. 3. *pp.* 280–285, 1935.—The elevation of the geoid is calculated on the assumption that the disturbing mass is present as a plane coating and not spacially distributed. The results applied to the cases previously considered [see Abstracts 1517 (1934) and 580 (1935)] give results differing by less than 1 %. C. A. S.

1052. Are Large Polar Displacements Possible? R. Schwinner. *Gerlands Beitr. z. Geophys.* 43. *pp.* 296–310, 1934.—Reference is made to Milankovitch's view, which is opposed to that of other geophysicists, that a shifting of the earth's axis has moved the north pole during geological ages from the Sandwich Islands across Alaska to its present position and the motion will continue to bring it to the mouth of the Petchora [see Abstract 3606 (1934)]. It is shown that the view is in opposition to the conservation of energy. The suppositions on which it is based, such as the invariability of the sial as a spherical shell, and the exclusive action of the force of polar flow, must be rejected by geologists, and it is considered that no conclusive physical arguments have been given for such considerable deviations of the north pole. **M. Milankovitch** in reply outlines his mathematical procedure and assumptions and while accepting that the sial covering may not be invariable, as assumed, during its motion, the integration fulfils the mathematical problem set up even if it is not accepted by geologists.

R. S. R.

1053. Calculation of the Polar Drift Force. L. Grabowski. *Gerlands Beitr. z. Geophys.* 43. 3. *pp.* 311–330, 1934.—A critical examination is made of the results obtained by Milankovitch [see Abstract 3606 (1934)] and Ertel [see Abstract 752 (1932)] on the mechanism of polar displacements. (i) If one assumes with Milankovitch that the expression for gravity potential: $W = \frac{fM}{r} + \frac{C-A}{r^3}(1 - 3\sin^2\phi) + \frac{1}{2}w^2r^2\cos^2\phi \ldots (1)$, ought to be employed also within the earth's crust then the polar drift force can be derived by the formula $dH = \frac{Z_s}{r_0} \cdot d\mu(g_v - g_a)\sin 2\phi_0 \ldots (2)$, or the formula $\frac{dH}{Z_s\,d\mu} = \frac{g_v - g_a}{r_0}\sin 2\phi_0 = \frac{g_a}{r_0}\beta\sin 2\phi_0 \ldots (3)$. (ii) If one makes no assumptions for the potential expression inside the earth, as Ertel does, then without closer knowledge of the mass distribution in the earth's crust, or making assumptions regarding it, no solution is generally possible. Ertel's formula for the calculation of the polar drift force is considered incorrect. **M. Milankovitch** in reply refers to equation (1)and explains why he considers Grabowski has misunderstood its application. Reasons are given for the form obtained and the assumptions made. **H. Ertel** in reply refers to the derivation of b_ϕ and the assumptions made, and considers that the errors in his equation do not exceed 1 %. R. S. R.

GEOPHYSICS, APPLIED.

***1054. Magnetic Method in Geophysical Prospecting. A. Graf.** *A.T.M.* 3. T160–161, *Dec.*, 1934.—The Askania universal magnetometer for measuring both vertical and horizontal field components is described. Its sensitiveness, corrections and field applications are discussed. The greatest utility of the magnetic method is found in the search for magnetic ore bodies. W. A. R.

1055. Potential Distributions About an Electrode on the Surface of the Earth. Part II. M. Muskat. *Physics*, 6. *pp.* 14–26, *Jan.*, 1935.—The analytical theory is given for the potentials and gradients to be found on the surface of a horizontally stratified earth in which the current source is an infinitely extended cable or line electrode lying on the surface. Power series expansions in the distance from the electrode are derived for small distances and asymptotic expansions for large distances. Detailed treatments are given for the two-layer earth, for all thicknesses of the surface layer, and for the three-layer earth in which the thickness of the second layer either equals or is twice as great as that of the surface layer, as well as formal expansions for general many-layered earths. Simple closed hyperbolic expressions are derived for the surface gradients for three-layer systems in which the lowest layer is either of infinite or zero conductivity. The solution for the direct interpretation problem in which the continuous vertical conductivity variation may be determined from a knowledge of the surface gradients is briefly outlined, following the method of Slichter and Langer for the case where the current source is a point electrode. The analytical results of the indirect interpretation problem for a stratified earth are illustrated by thirty numerical and graphical examples. [For Part I see Abstract 2883 (1933).] AUTHOR.

1056. Mixed Boundary Value Problems in Logarithmic Potential Theory. M. Muskat. *Physics*, 6. *pp.* 27–32, *Jan.*, 1935.—A method is given for solving logarithmic potential problems in which the potential is preassigned over part of the boundary and the normal derivative over the remainder. A " mixed " Green's function is defined such that it vanishes over part of the boundary of interest and its normal derivative vanishes over the remainder, and the solution for the logarithmic potential is expressed in terms of this function and the boundary conditions of means of Green's theorem. Taking the case of the infinite quadrant as the " prototype " region the solutions for other regions such as the infinite half plane, infinite and semi-infinite strips, and the circle are obtained by mapping them on the infinite quadrant; these are illustrated by several specific examples. AUTHOR.

See also Abstract 1222.

LAND, PHYSICS OF THE.

1057. Elasticity of Rocks by the Method of Restitution. (Miss) J. Roess. *Comptes Rendus*, 200. *pp.* 147–149, *Jan.* 7. 1935.—A combined mechanical and photographic method is described for determining the coefficient of restitution, ϵ, by measuring the height, h, to which a steel ball rebounds when dropped on a polished surface of the rock from a height, H, ϵ beiug defined as $=\sqrt{h/H}$. C. A. S.

1058. Determination of Grain-Size Distribution in Sediments by Statistical Methods. W. B. Gealy. *Univ. Pittsburgh, Bull.* 31. *pp.* 108–118, *Oct.* 1, 1934.—Statistical methods of treating data presented in the normal or the logarithmic grain-size frequency curve are analysed and the derived constants are summarised in relation to one another. For the study of (geological) sediments a class ratio of $\sqrt{2}/1$ is preferred; measures of average grain-size, of dispersity and of skewness and the light they throw on the origin of geological dispersions are illustrated by reference to data for typical sands and sediments. L. V. C.

1059. Fineness Test of Moulding Sand. C. E. Jackson and C. M. Saeger, Jr. *Bureau of Standards, J. of Research,* 14. *pp.* 59–65, *Jan.* 1935.—The fineness, or the size distribution, of the constituent particles of a material is an important factor in determining many of the physical characteristics. No great difficulty is encountered in sizing the larger particles by the use of sieves, but for particles finer than 50 microns in diameter other methods must be employed. The pipette method has been satisfactorily used in analysis of particle sizes of soils. Details of the development and use of the pipette method in the fineness test of moulding sands are outlined in this paper. The method of computation and scope of results are shown by typical examples. A rapid method suitable for foundry control work and routine testing is suggested. AUTHORS.

1060. Exhalation of Radon from the Soil and its Dependence on Meteorological Factors. Part II. W. Kosmath. *Gerlands Beitr. z. Geophys.* 43. 3. *pp.* 258–279, 1935.—The results obtained by the author's method at Liebenau-Graz (Styria) during 1933–4 are discussed. The average, maximum, and minimum amounts ($\times 10^{18}$ curie/cm.^{2}/sec.) observed were for 1933, 54, 248 and 70 and for 1934, 25, 70 and 0 respectively. The average content per cc. of the upper 2 m. of the soil is 10^{-13} curie. These results are compared with those of Bender at Innsbruck [see Abstract 3207 (1934)]. The influence of meteorological factors (cloudiness, sunshine, rain, frost, etc.) is considered, but no very direct connection is elucidated. All variations however, seem explicable as due to such variation in the porosity of the soil as may be caused by these factors. [For Part I see Abstract 119 (1934).] C. A. S.

See also Abstracts 1052, 1053, 1064.

METEOROLOGY.

1061. Density of the Upper Atmosphere Calculated from Twilight Phenomena. F. Link. *Comptes Rendus,* 200. *pp.* 78–80, *Jan.* 2, 1935.—The variation of the brightness (b) of the sky at the zenith has been measured at Rysy (2300 m.) for different depressions (U) of the sun below the horizon. $(1/b)db/d\mathrm{U} = \beta \sin \mathrm{U}$ or $\log b = -\beta \cos \mathrm{U} + \mathrm{Const.}$ is the relation used. From the observations β can be deduced in terms of U and the expression holds for secondary diffusion with U between 5° and 15°. Also U can be expressed in terms of the altitude, h. The results agree well with density values deduced by Lindemann and Dobson from observations of meteors. R. S. R.

1062. Vertical Distribution of Atmospheric Ozone in High Latitudes. A. R. Meetham and G. M. B. Dobson. *Roy. Soc., Proc.* 148*A*. *pp.* 598–603, *Feb.* 15, 1935.—Observations to determine the vertical distribution of ozone in the atmosphere, similar to those recently made at Arosa, have been carried out at Tromsö, N. Norway, in May and June, 1934. They show that the average height of the ozone is very slightly lower at the higher latitude, and indicate that at Tromsö the ozone is more concentrated in a region centred at a height of 21 km. above sea-level, whereas in Switzerland it is more uniformly distributed through the lower 30 km. AUTHORS.

1063. Formula for Index of Aridity. E. de Martonne and (Mrs.) Fayol. *Comptes Rendus*, 200. *pp.* 166–168, *Jan.* 7, 1935.—The formula in its original form given some eight years ago was $I = P/(T + 10)$ or $i = 12P/(T + 10)$, the first for the annual mean, the second for the monthly means. T denotes the temperature and P the precipitation in a certain locality. The present note deals with several modifications of the original form. In this way it is possible to differentiate between stations which according to the original formula gave almost the same value for the index, *e.g.*, on one of the new formulæ Paris and Marseilles give 1, 25 and 17 respectively, as against 28 and 24 on the old. A. E. M. G.

1064. Influence of Earth-Movements on Climate. R. G. Lewis. *Geolog. Mag.* 72. *pp.* 64–73, *Feb.*, 1935.—After referring to early ideas regarding glaciation it is shown how these hypotheses do not account for the observed facts. From a study of the behaviour of different areas of glaciation the author considers that the movements of the earth's crust account for these, an elevation being accompanied by a disappearance of ice, a subsidence by a period of glaciation. On the other hand with temporary depression or elevation of small amount, a warmer spell comes with depression and cold with elevation. This accords with the geographical theory of glaciation but as the author points out geological findings do not always support this. The effect of small earth movements on the climate in the Thames valley is discussed, the investigation being illustrated by diagrams, when it is seen that the influence of earth movements is entirely in agreement with the geographical theory. Earth movements are adduced also as providing a gradient for ice flow. From his investigation the author concludes that there exists a connection, not yet elucidated, between local change of climate and local crustal movement. A. E. M. G.

1065. Ultra-Violet Transparency of the Atmosphere and the Possibility of Detecting the Solar Spectrum in the Region, 2200-2000 Å. K. R. Ramanathan and L. A. Ramdas. *Indian Acad. Sci., Proc.* 1*A. pp.* 308–314, *Nov.*, 1934.—The ultra-violet limit of observation of the solar spectrum (about 2900 Å) is set by ozone in the upper atmosphere, since O_3 has a strong absorption band $\lambda\lambda$3200-2200 (maximum at λ2550). If the sun radiates as a black body at about 6000° K., its spectrum should be observable beyond λ2200 in the absence of any other absorber than O_3. The failure of all attempts to observe solar radiation in this region indicates the presence of another absorber. This is oxygen in the lower atmosphere. O_2 has two absorption band systems beyond the O_3 band, namely (i) the Schumann-Runge system with absorption bands from about λ2000 to the convergence point λ1751 and a continuum to λ1300, and (ii) Herzberg's system of weak bands between $\lambda\lambda$2600 and 2420 with a probable continuum beyond these. From a consideration of experimental data, it is concluded that solar radiation beyond λ2200 is unlikely to be detected from any point on the earth's surface, but should be observed (to about λ1950) at heights of about 16 km. if spectrographs of powers usual for terrestrial investigations could be used at such heights and if the upper atmosphere contains no other absorber which is not present in the lower atmosphere. Such heights are attainable by sounding balloons and by manned stratosphere balloons. W. J.

1066. Origin of Night Sky Spectrum, 5000 to 8000 A. J. Cabannes. *J. de Physique et le Radium*, 5. *pp.* 601–613, *Dec.*, 1934.—The observations are partly those already published [see Abstract 3219 (1934)], which are described in more detail. In the region studied the spectrum is here fully analysed with tables of line identification and of comparison with other observations. A discontinuous spectrum of atmospheric origin is found; and proves to be identical with that of the aurora, with the so-called green and red auroral lines predominating. The former of these is attributed to O I; otherwise the spectrum is in essentials made up of the first positive system of the N_2 molecule, the terrestrial O_2 bands, and the molecular spectrum of H_2O. Theoretical explanations of the principal characteristics are given. T. L. M.

1067. Infra-Red Albedo of Snow. J. Devaux. *Comptes Rendus*, 200. *pp.* 80–81, *Jan.* 2, 1935.—Continuing earlier observations [see Abstract 4003 (1933)] comparisons were made of the solar radiation diffused by snow with that by a sample of quartz and having the same illumination. The radiation was reflected and concentrated upon a thermopile contained in a laboratory upon the Pic du Midi and photographic registrations made of the galvanometer deflections. A series of observations with different wave-lengths shows minima for diffusion near to 1·0μ and 1·2μ which correspond to absorption bands for water or ice. R. S. R.

***1068. Hair Hygrometry. W. Grundmann.** *Zeits. f. Instrumentenk.* 54. *pp.* 441–451, *Dec.*, 1934.—A large series of experiments was performed to determine the change in length of hairs with change of temperature and relative humidity, the elastic response of hairs to loading and the influence of preliminary treatment on the results obtained. The different types of apparatus used in the tests are fully described. The extension of hairs when loaded is found to depend on the relative humidity of the air, the type of hair used, and the rapidity of change of load while more uniform results are obtained by preliminary treatment. Values vary, however, from one hair to another of the same type. Gay-Lussac's law for the change of length is true only between 10° C. and 30° C. and the deviations are considerable at higher and lower temperatures in the middle range of relative humidity (30 % to 80 %), while it depends also on any preliminary wetting of the hair. A non-regular scale is thus required for a hygrograph. Acid and alkali impurities in the air affect the extension, some more rapidly and to a greater degree than others and cleansing of the hairs is essential. Tests on the hairs were continued down to − 70° C. and irregular results are obtained below − 45° C. The lag in the hair response to humidity changes depends on the rate of air flow and on the temperature. Tests with animal hairs show that good results may be obtained with horse hair after suitable preliminary treatment. R. S. R.

***1069. Aircraft Apparatus for the Establishment and Measurement of Thermal and Atmospheric Disturbances. B. Claus and F. Kohlitz.** *Zeits. f. techn. Physik*, 16. 1. *pp.* 16–18, *Jan.*, 1935.—Former apparatus depended for its observations upon barometric changes and there was a lag between the onset of the disturbance and the record of the observation. This led to much loss of detail in measuring vertical air movements for use by gliders. Particulars are given of the construction, and principles of action of the new instrument which has electrical operation. The thermal sensitivity characteristic shows its much more rapid action than the old variometer and its indication of smaller temperature differences.

It will indicate temperature differences due to surface irregularities of contour, surfaces of water, sandy surfaces, and surfaces heated by the sun. R. S. R.

See also Abstracts 1049, 1060, 1077, 1078, 1084, 1086, 1119.

SEISMOLOGY.

1070. Development of the Wave Conception. Part VIII. K. Uller. *Gerlands Beitr. z. Geophys.* 43. 3. *pp.* 289–295, 1934.—An expression is set out for the solution of the field of an elementary form of oscillation as a damped sine oscillation. It can be considered as of two phases, sine and exponential, which differ from one another only in the limit. The effects of locally varying fields are considered and the conditions, under which the solutions given are valid, are discussed. [For Part VII see Abstract 1946 (1934).] R. S. R.

1071. SL and SM Waves. P. Caloi. *Com. Geod. e Geofis., Boll.* 4. *pp.* 134–146, *Oct.*, 1934.—New and clear examples of SL and SM waves have been obtained from different earthquakes at several stations. These new records prove the real existence of these phases and enable them to be studied. They have a purely longitudinal character, and have proved useful in the determination of the azimuth of the epicentres of some earthquakes. W. A. R.

1072. Amplitudes of Dispersive Rayleigh-Waves at Different Depths. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 641–649, *Dec.*, 1934. *In English.*—Generally speaking the amplitudes of seismic waves within a body decrease with the depth. This law of decrease appears to be modified in a stratified body. A study of the dispersion curves of Rayleigh-waves indicates some anomalous features in the distribution of amplitudes. W. A. R.

1073. Propagation of Seismic Waves. Part II (continued). H. Kawasumi. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 660–705 *and* 854–856, *Dec.*, 1934. *In English.*—The author's views are illustrated with reference to the Ise Bay earthquake of June 2, 1929, which is concluded to be of Hasegawa's B type, with epicentre at 34° 30′ N., 136° 54′ E., and focus 300 km. deep, the energy carried by seismic waves being $3 \cdot 7 \times 10^{19}$ ergs per sec., and total energy 10^{21} ergs. The possibilities of deducing crustal structure from (*a*) the "pull-push" distribution of shallow earthquakes, and (*b*) the magnitude of the initial movements are discussed with reference (for *a*) to the earthquake in Sagami (June 27,1928), and (for *b*) to those in N. Idu (Nov. 25, 1930), Ito (Mar. 23, 1930), W. Saitama (Sept. 21, 1931), and Tango (Mar. 7, 1927). While undoubtedly such information is deducible the "necessity of higher accuracy in seismometric observations is keenly felt for such a purpose." [See Abstract 557 (1934).] C. A. S.

1074. Free Vibrations of a Structure. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 804–822, *Dec.*, 1934. *In English.*—The periods of natural vibrations of framed structures, having different conditions as regards the connection of columns with floors and bases are determined mathematically and also general criteria concerning the resistance of a building to horizontal vibrations. Three cases of construction are taken, (*a*) clamped fixing of columns at the floors as well as at the base, (*b*) clamped fixing of columns at the base and their supported fixing at the floors, and (*c*) hinged fixing of columns at the base and clamped fixing at the floors. The results are tabulated for one to four floors. It is found that in cases (*a*) and (*b*) the periods of free vibrations increase linearly as the number of floors increases, while for (*c*) the period increases roughly as the square of the number of floors. The problem is finally extended to a structure having columns of successively varying sections and the results are compared with those found by Saita. [See Abstract 60 (1933) and following Abstract.] R. S. R.

1075. Forced Vibrations of a Structure. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 823–853, *Dec.*, 1934. *In English.*—Forced vibrations of a structure were examined particularly where the ground movements were horizontally polarised and of the simple harmonic type. Structures of 2, 3 or 4 stories were considered with the same types of clamping as in an earlier paper [see preceding Abstract], and the periods of vibration determined. A comparison was made of the periods where resonance occurred and where the bending moments of some columns vanished and the magnitudes of the bending moments of columns at very low frequencies were found. The theory of the radiation and dissipation of the vibrational energy into the ground was developed and compared with the results found by Tanakadate, Mano, Omori, and Taniguti. The action of oscillators on the vibrations of a structure was investigated and their use to prevent vibrations and large bending moments in the columns. Four methods are outlined to prevent vibrations. Finally, an empirical equation for forced vibrations of structures is developed. R. S. R.

1076. Physical Evaluation of Seismic Destructiveness. H. Benioff. *Seismological Soc. of America, Bull.* 24. *pp.* 398–403, *Oct.*, 1934. —By plotting the maximum recorded deflection of each of a series of undamped pendulum seismometers against its frequency, a curve is obtained which may be called the undamped pendulum spectrum of an earthquake. Seismic destructiveness is defined as the area between this curve and the X-axis. This method has a straightforward application to the design of earthquake resisting structures. W. A. R.

1077. Microseisms and Depressions in Western Europe and on the Ocean. S. W. Visser. *K. Akad. Amsterdam, Proc.* 37. 10. *pp.* 738–746, 1934.—A close relation exists between microseisms in Western Europe and the presence of cyclones over the ocean. A relation also exists between the state of the sea and microseisms, but it is not so close. The microseisms are largest in the direction of the cyclone track. This correspondence has afforded a satisfactory basis for weather prediction. W. A. R.

1078. Relation Between Cyclones and Earthquakes. S. Yamaguti. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 742–753, *Dec.*, 1934. *In English.*—"Deep" earthquakes rarely occur very near cyclonic centres, but a remarkable maximum frequency appears to exist about 900 km. distant from the cyclonic centres. There are certain azimuths, referred to the direction of propagation of the cyclonic disturbance, that seem to be favoured by different kinds of earthquake. There is also a probable positive correlation between the pressure gradient and the depth of the epicentre. W. A. R.

1079. Time and Space Distribution of Earthquakes. S. Yamaguti. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 754–758, *Dec.*, 1934. *In English.*—A reply to the criticism of Whipple [see Abstract 2818 (1934)]. W. A. R.

***1080. New Seismic Instrument. P. G. Alfani.** *Com. Geod. e Geofis., Boll.* 4. *pp.* 130–133, *Oct.*, 1934.—A new instrument for measuring vibrations and accelerations is described. It is essentially the application of an elastic rubber tube to the Marey apparatus. The fluctuations of pressure within the tube, due to the distortion of the apparatus, are registered. It is claimed that the apparatus eliminates many inertia effects and is aperiodic. W. A. R.

***1081. Extensometer for Measuring Crustal Deformation. R. Takahasi.** *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 760–775, *Dec.*, 1934. *In English.*—Two substantial concrete blocks are fixed in the soil 25·05 m. apart. One end of a horizontal fused silica tube of approximately the same length floating in a long trough, is rigidly attached to one, while at the other end is a delicate arrangement for measuring relatively to the length of the tube any variation in the distance between the blocks. The whole is placed in a deep trench and roofed over. Calculations are given showing the changes in the length of the tube due to change in temperature, air pressure, water level in the trough, etc. C. A. S.

***1082. Velocity Seismograph. T. Hagiwara.** *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 776–787, *Dec.*, 1934. *In English.*—The essential principle of the instrument is that when the pendulum is strongly damped—far beyond the critical limit—its deflection is proportional to the velocity of the earth movement. This is applied by making small modifications in the Ishimoto acceleration seismograph [see Abstract 355 (1932)]. The pendulum is inverted, and a strong air damper of piston type giving a damping constant of about 10 (one of higher constant would be better) is attached thereto. The apparatus is figured, and details of working calculated. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1083. Relative Humidity and Ratio of Large Ions to Total Nuclei. H. L. Wright. *Terr. Mag.* 39. *pp.* 277–280, *Dec.*, 1934.—Theoretical reasons are advanced which support the observation, noted by O. W. Torreson [see Abstract 2418 (1934)], that the diurnal variation of the ratio N_1/N closely resembles the diurnal variation of relative humidity. A formula is obtained which relates the ratio N_1/N to the radius of nuclei. AUTHOR.

***1084. Atmospheric Dust Recorder. R. A. Nielsen.** *Terr. Mag.* 39. *pp.* 281–292, *Dec.*, 1934.—A new device for continuously recording the dust-content of the air has been used to obtain records of atmospheric dust at Stanford University, California. Continuous dust-records from January 13 to March 17, 1934, have been taken and the variations in the dust-content of the air correlated with other atmospheric phenomena recorded at this station. In particular, the space-charge tended to vary inversely as the dust-content, while the potential gradient seemed to be unaffected by changes in the amount of dust. AUTHOR.

1085. Summary of Year's Work, Department of Terrestrial Magnetism, Carnegie Institution of Washington. J. A. Fleming. *Terr. Mag.* 39. *pp.* 333–340, *Dec.*, 1934.—The work of the Department during the report-year July 1, 1933, to June 30, 1934, is grouped under (1) Reduction and study of observational material already gathered; (2) Development of methods and technique to obtain continuous records of the electrical conditions in the ionosphere; (3) continued attack in the laboratory on basic phenomena of magnetism by work in nuclear physics; (4) maintenance of field operations. During magnetically disturbed years the vertical force tends to be higher than during quiet years. This is interpreted to denote that the external magnetic field of the earth undergoes an 11-year periodic change having a maximal value during magnetically disturbed years. The examination of 151 sudden commencements at Watheroo leads to the view that two or more causes are operative in sudden commencements, one terrestrial and the other extra-terrestrial. Observations at Huancayo on the upper atmosphere show that three sharply defined increases of ionisations of " layers " are ordinarily apparent in the daytime with near-normal incidence of the sun's rays, having virtual heights of about 100, 180 and 300 km. corresponding to the E, F_1 and F_2 layers of the temperate zones. The F_1 and F_2 layers separate from a single F layer which exists at night. In nuclear physics research, tests of the electrostatic generator showed that the maximum positive potential attainable was 1200 kV. It was found that heavy hydrogen occluded on the solid targets was a contamination responsible for disintegration effects observed when using deutons. With about $0 \cdot 5$ μA of deutons at 1200 kV. bombarding a Be target, a source emitting more than 500 million neutrons per sec., was demonstrated, 10 to 100 times as great as the strongest radioactive source so far reported. Evidence for the existence of stable hydrogen atoms of mass 3 was found. The activities at various observatories are described. [See also Abstract 1952 (1934).] G. E. A.

1086. Thunderstorms. H. Noto. *Radio Research, Japan, Reports,* 4. *pp.* 121–166, *Oct.*, 1934. *In English.*—The results of measurements at Tokyo of electric field changes during the passage of thunderstorms indicate that no clear determination of cloud polarity is possible according to the Wilson or Simpson schemes mainly because of the irregular volume charge and involved structure of the clouds. Comparison with upper wind measurements showed that the travel of a thunderstorm was largely controlled by winds at heights of 2000–3000 m. or more. Investigation of the structure of the cloud shows it to be composed of many masses separated by thin layers and also having different signs. Sometimes they occur in couples in parallel or in a row and along a " front " many may occur. The conductivity in a cloud is greater than in dry air and at higher levels it is affected by barometric pressure. From the size, water content and potential gradient the volume charge was calculated. Different impurities contained in rain and snow were measured for different places and times and it was concluded that the amounts were never sufficient to alter the sign of the charge when separation of the drops occurred but they affect seriously the theory of the thunderstorm. Also the differences of polarity of clouds were not due to impurities. R. S. R.

***1087. New Method of Registering Atmospherics. R. Failletaz.** *Comptes Rendus,* 199. *pp.* 1647–1648, *Dec.* 26, 1934.—The principle of a method of registering atmospherics specially suitable for indicating the approach of thunderstorms is described. The apparatus was used at Tamanrasset in autumn 1933, during the Polar Year. It gives four curves representing the mean activity of the atmospherics in the directions of the four cardinal points. The arrangement permits of registering on short waves owing to its high sensitivity. The instrument as erected at Tamanrasset was fed by four directed aerials. It is now erected at the Observatory at Trappes with movable frame aerials. A. E. M. G.

1088. Foci of Atmospherics and their Localisation. R. Bureau. *Comptes Rendus*, 200. *pp.* 82–84, *Jan.* 2, 1935.—Atmospherics determined by goniometric localisation are dealt with first, and two distinct methods or a combination of both may be used, these depending upon the instantaneous opposition of two atmospherics. The apparent direction and intensity of the field are indicated. Non-goniometric localisation with diurnal variation in the propagation of the waves for distant sources may be used for (*a*) nocturnal and (*b*) sunset atmospherics. Features of each are considered and also the variations with wave-length and the rapid rotation of the focus for near sources. R. S. R.

1089. Potential Acquired in the Natural Electric Field by a Vertical Rod Standing on the Ground, Insulated at the Bottom and Carrying a Collector at the Top. L. H. G. Dines. *Phys. Soc., Proc.* 47. *pp.* 218–234, *March*, 1935.—This paper investigates the potential of a small cylindrical rod standing upon, and insulated from, a charged plane, and provided with a small collector at the top. Data of a direct observational comparison between such a rod and a standard piece of apparatus are given. The main part of the paper consists of a theoretical determination of the potential of the rod by means of an approximate solution of the integral equation involved. The investigation is extended to cover a certain range of values of the ratio of the diameter to the height of the rod. An attempt is made to indicate the distribution of charge on the surface of the rod in a special case. An estimate is made of the subsidiary error involved when the collector takes the form of a horizontal fuse which shortens as it burns away. AUTHOR.

1090. Auroral Height Measurements and Observations at Chesterfield, Canada. B. W. Currie. *Terr. Mag.* 39. *pp.* 293–297, *Dec.*, 1934.—This account deals mainly with the results of double station photographic observations of aurora taken during the winter of the Polar Year. The methods of observation and measurement are indicated. Results for height distribution are similar to those found over Norway. Quiet forms show a distinct frequency maximum about 105 km. When all forms are included the mean value rises to 115·6 km. No very low values were recorded, the lowest measured value being 71 km. The mean direction of the arcs and bands from 134 observations is 98·7°. The time of daily maximum auroral activity is shown graphically to occur at local magnetic midnight. The paper is illustrated with photographs of typical auroral forms. A. E. M. G.

***1091. Apparatus for Measurement of Earth's Electric Field. E. Medi.** *Accad. Lincei, Atti*, 20. *pp.* 381–384, *Nov.* 18, 1934.—The earth's electric field is compensated by an artificial potential and reduced to zero. A plane surface raised to a known potential is placed near a second insulated plate surrounded by an earthed guard ring. Any charge on the insulated plate can be collected by a Faraday's pail and discharged to earth through a valve amplifier, giving a note in a telephone. The number of charges and discharges per sec. can be regulated automatically. By altering the relative position of the plates, a point is found when no noise is heard in the telephone. Then the field is calculated. The method is quick and the apparatus portable. H. M. B.

See also Abstracts 1121, 1123, 1257.

RADIOACTIVITY.

1092. Simple Method for Investigating Polonium Preparations. Berta Karlik and Elisabeth Rona. *Phys. Zeits.* 36. *pp.* 27–28, *Jan.* 1, 1935.—The difficulties attending the ionisation method of investigating strength and α-particle range of Po preparations are discussed. The method of ZnS scintillations avoids these difficulties and uncertainties [see Abstract 4841 (1933)] and the authors have tested the method in a number of recent investigations. For example they have shown by the method that the range of α-particles from a given preparation decreases with time. With one preparation the decrease corresponded to the covering of the preparation with a layer equivalent to 0·6 mm. air. The range alteration may not be simply due to a covering layer but to the penetration of the polonium into the underlying metal surface. In an atmosphere of CO_2 the covering effect may reach a value equivalent to 1–2 mm. air. J. E.

1093. X-Ray Levels of Radioactive Elements with Applications to β- and γ-Ray Spectra. A. E. Ruark and F. A. Maxfield. *Phys. Rev.* 47. *pp.* 107–114, *Jan.* 15, 1935.—A table of X-ray levels of radioactive elements, believed to be more reliable than those hitherto employed, is given. The energies of certain γ-rays of Th B·C, Th C″·D, Ra C·C′, Ac B·C and Ac C·C″ are recalculated from the known β-ray energies with satisfactory results. The use of the new levels in calculating the energies of Auger lines is shown to be justified and those of Rd Ac·Ac X, Ac X·An and Ms Th_2·Rd Th are discussed. New conclusions are drawn from a reconsideration of the β- and γ-ray spectra of Pa, RdTh, UX_1 and UX_2. W. E. P.

1094. Upper Limit of Thorium C + C″ β-Ray Spectrum. P. C. Ho. *Cambridge Phil. Soc., Proc.* 31. *pp.* 119–124, *Jan.*, 1935.—Experiments on the β-ray spectrum of thorium C + C″ by the Wilson cloud chamber method were made. From a certain number of photographs taken, the upper limit of the continuous spectrum was found at 9250 $H\rho$ and no β-particles of higher energy were observed. This value for the upper limit agrees fairly well with the result obtained by Henderson's recent experiments by the method of Geiger-Müller counter and focusing magnet [see Abstract 218 (1935)]. AUTHOR.

1095. Radioactivity of Potassium and Rubidium. O. Klemperer. *Roy. Soc., Proc.* 148*A*. *pp.* 638–648, *Feb.* 15, 1935.—The long life of K (or Rb) and the high velocity of the emitted β-rays conflict with Sargent's rules [see Abstract 2326 (1933)] concerning the β-emission and with Fermi's theory [see Abstract 1547 (1934)]. Three hypotheses (β-coincidences, α-β-decay, β-β-decay) suggested by Gamow in order to explain the above-mentioned contradiction have been tested experimentally. It has been found that no one of the processes suggested exists. Arguments are given to show that probably the relatively rare isotopes K^{40} and Rb^{86} exist and are responsible for the radioactivity of potassium and rubidium. The existence of a nuclear spin 4 or 5 of the K^{40} isotope would clear up the above-mentioned contradiction between lifetime and β-velocity. The discussion shows that such a high nuclear spin for K^{40} is quite reasonable. AUTHOR.

1096. Internal Conversion of γ-Rays with the Production of Electrons and Positrons. J. C. Jaeger and H. R. Hulme. *Roy. Soc., Proc.* 148*A. pp.* 708–728, *Feb.* 15, 1935.—A radioactive nucleus is considered as a radiating dipole or quadripole, and expressions are obtained for the number of pairs created by the absorption of the γ-rays emitted by the nucleus. The effect is not sensitive to changes in the atomic number of the nucleus, and increases with the energy of the γ-ray. For energies in the region of $5mc^2$ it is of the order 10^{-4} to 10^{-3} pairs per γ-ray quantum. In this range it is found that the number of positrons emitted per unit energy range increases steadily with the energy of the positron, which therefore takes up most of the available energy. For very light elements, typified by the case $Z = 0$, there is symmetrical distribution of the energy between positron and electron. The results have been compared with those obtained experimentally by Alichanow and Kosodaew, who have examined the number of positrons emitted by a radioactive source, and the agreement is satisfactory when the difficulty of obtaining a good experimental value is considered. AUTHORS.

1097. Electrical Deviation of Ultra-Radiation Particles. E. Lenz. *Phys. Zeits.* 36. *pp.* 24–26, *Jan.* 1, 1935.—The deviation of ultra-radiation particles for the purpose of energy measurements was produced by an electric field in a condenser in nitrogen at a pressure of 30 atmospheres. Four tube counters on the coincidence principle used by Rossi [see Abstract 4047 (1930)] were employed. The counters were on a vertical line and the tubes pointed east and west. The plate condenser was between the inner tubes, and the lowest tube could be displaced to either side. Graphs are given of the hourly coincidences with and without an applied field. With a field of 700 V/cm. a lateral displacement of the particles of 1 cm. corresponds to a particle energy of 10^7 eV. When the field intensity is 70,000 V/cm., 1 cm. displacement is equivalent to 10^9 eV. The particles with increasing field are more and more displaced, and with the highest field there are no longer any coincidences in the lowest tube counter. Two different groups of particles are present, soft ones up to 10^7 eV., and hard ones over 4×10^8 eV. The soft particles are unable to penetrate the enclosure which has a 10 ± 1 cm. lead equivalent. G. E. A.

See also Abstracts 1060, 1114, 1232, 1252.

RADIATION.

ABSORPTION AND TRANSMISSION.

***1098. Light Filters for the Mercury Lamp. E. J. Bowen.** *Chem. Soc., J. p.* 76, *Jan.,* 1935.—The filters recommended are made of nickel-cobalt-sulphate. These transmit the ultra-violet while practically cutting off all the visible, infra-red, and the **3660** Å line. The filters must be free from traces of iron salts. [See Abstract **4893** (1932).] J. K.

See also Abstract **1134.**

COLORIMETRY.

See Abstract **1134.**

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1099. Variations of Magnetic Birefringence of Cerium Salts in Solution. C. Haenny. *Comptes Rendus,* 200. *pp.* 56–58, *Jan.* 2, 1935.—The present paper records the magnetic birefringences of six solutions of cerium salts in water in the presence and also absence of free acid, and in alcohol. These data have been calculated from measurements of paramagnetic anisotropy [see Abstracts **230** (1935) and **5250** (1934)]. It is found that the birefringences of cerium salts are strongly influenced by the nature of the solvent and especially by that of the anion. The optical anisotropies relating to the paramagnetic particles of the different solutions present considerable differences among themselves. It is concluded that this birefringence is essentially an ionic property. H. H. Ho.

1100. Faraday Effect of Strong Electrolytes in Aqueous Solutions. Part II. A. Okazaki. *Ryojun Coll. Eng., Mem. pp.* 209–212, *Dec.,* 1934. *Inouye Comm. Vol. In English.*—An addendum to a previous paper [see Abstract **2437** (1934)]. The values of the corrected specific and molecular rotations of HCl, LiCl, NaCl and KCl are calculated. With the first two the corrected molecular rotation decreases with increasing concentration more rapidly than the molecular refractivity, whereas with the last two salts the decrease of both quantities is very slight. The departure from constancy of the corrected molecular rotation of these electrolytes is attributed to the existence of undissociated molecules in concentrated solutions. On the basis of a given formula the numbers of dispersion electrons per molecule were evaluated to be 4·27, 4·00, 4·38 and 6·20 respectively. G. E. A.

1101. Natural and Magnetic Rotatory Powers of Pinene Vapour. P. Gabiano. *Comptes Rendus,* 199. *pp.* 1607–1609, *Dec.* 26, 1934.—The natural rotatory power of α-pinene vapour is found to be proportional to the pressure of the vapour, *i.e.*, the specific rotatory power is independent of the density of the vapour at constant temperature, and is equal to that of the liquid. The value of Verdet's constant for the vapour, under normal conditions, is 11×10^{-5} min.; the value of the molecular constant is 2·45 min. The specific magnetic rotation of the liquid has been found by Darmois to be $2{\cdot}29 \times 10^{-2}$ min. for the green mercury line; the author finds the value $1{\cdot}80 \times 10^{-2}$ min. for the vapour. The ratio of these two values, *viz.*, 0·77, is very near the theoretical value deduced from the refractive index of the liquid. J. S. G. T.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

1102. Luminescence of Thorium Oxide Activated by Rare Earths. Optimum Concentration for Different Sources of Excitation. Frances G. Wick and Charlotte G. Throop. *J.O.S.A.* 25. *pp.* 57–62, *Feb.*, 1935.—Three sets of specimens were prepared in which thorium oxide contained as activators praseodymium, samarium and terbium in concentrations varying by known amounts. The specimens activated by praseodymium varied from 1 atom of praseodymium in 100 molecules of thorium oxide to 1 atom in 100,000 molecules; those activated by samarium from 1 atom in 15·5 molecules to 1 atom in 2000 molecules; those activated by terbium from 1 atom in 10 molecules to 1 atom in 40,000 molecules. The intensity of luminescence of specimens in each set was measured and the concentration of greatest brightness, the optimum concentration, determined for each of the following sources of excitation—kathode rays, ultra-violet light and hydrogen flame. The results show that the optimum concentration is different for each of the sources of excitation used. In all cases the concentration required for the optimum under kathode rays is less than that for the other methods of excitation used.

AUTHORS.

See also Abstracts 1092, 1106, 1181.

INTERFERENCE. DIFFRACTION AND SCATTERING.

1103. New Interference Phenomenon Observed with Crystalline Plates. K. S. Sundararajan. *Indian Journ. Phys.* 9. *pp.* 141–151, *Nov.*, 1934.—In the course of observations of the fringes produced in the spectrum when thin sections of birefringent crystals are examined between crossed nicols, a subsidiary set of interference fringes was observed. These are shown to be produced as a result of the variation with wave-length of the amplitude of the multiply-reflected rays. The theory predicts that the phenomenon will also be observed in ordinary unpolarised light, and photographs showing the effect, in a crystal of chrysene, for polarised and unpolarised light are reproduced. The phenomenon is also discussed in relation to Haidinger's fringes and Brewster's bands. C. B. A.

1104. Modification of Frequency of Scattered Light by Elastic Heat Waves in Liquids. J. A. Khvostikov. *Phys. Zeits. d. Sowjetunion,* 6. 3. *pp.* 343–350, 1934. *In English.*—Contradictory results having been obtained by two groups of observers for the scattering of light, the author used as source the light-blue Cd line 4678·3 Å, and showed that examination of the structure of scattered light with a Fabry-Perot etalon leads to the same results as a similar investigation with an echelon grating. The light scattered by benzol has components the frequency of which has been modified by the elastic heat waves. Numerical results agree with those of Gross, and the red displacement found by Cabannes in the scattered light spectrum was absent. [See also Abstract 2874 (1932).]

G. E. A.

See also Abstracts 1006, 1049, 1134, 1223.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1105. Photochemical Carbon Monoxide Oxidation. W. F. Jackson. *Am. Chem. Soc., J.* 56. *pp.* 2631–2635, *Dec.,* 1934.—The photochemical oxidation of CO has been investigated at room-temperature in a flow system and at high temperature in a static system. The room-temperature investigation shows that O atoms react with O_2 molecules to form ozone at least 150 times more rapidly than they react with CO to form CO_2. The high temperature investigation indicates that the dry oxidation is practically independent of temperature and total pressure. When water is present, however, the reaction rate is no longer independent of pressure and shows a large temperature coefficient. A mechanism involving H atoms and OH radicals has been suggested to explain the effect of water. AUTHOR.

1106. Optical Dissociation of InBr and InI. J. Sedov and A. Filippov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 374–377, *Dec.* 1, 1934. *In English.*—The salts, prepared from the action of the halogen on In were distilled into a quartz cell which was then sealed off. Excitation was by spark and arc. The luminescence shows the In lines 4101·8 and 4511·3 ($5^2P_{1/2,\,3/2} - 6\,^2S_{1/2}$). Exclusion of waves below 2200 by a gelatin or Iceland spar filter resulted in the disappearance of luminescence. The initial temperature of appearance of the luminescence is at 280° C. and the maximum intensity is at 450°. Long exposures at high temperatures gave also a resonance series at 4100 and a set of diffuse bands at 3300 Å. It is estimated that the long-wave limit of excitation is 2170 ± 30 Å. InBr gave similar results except that the long-wave limit is at 1960 ± 30 Å. The heats of dissociation calculated from the absorption limits give 75·5 ± 2·5 k.cal. for InBr and 62 ± 2 k.cal. for InI. J. E.

1107. Three New Phototropic Substances. A. P. de Carvalho. *Comptes Rendus,* 200. *pp.* 60–62, *Jan.* 2, 1935.—Phototropy is the property which certain substances possess of undergoing reversible colour changes under the influence of luminous radiation, and the author now records data for three substances in entirely new classes with respect to the occurrence of phototropy, *viz.*: diphenacyldiphenylmethane, tetraphenyl—2 : 4 : 4 : 6—dihydro—1 : 4—pyridine, and tetraphenyl—2 : 4 : 4 : 6—dibenzoyl—3 : 5—tetrahydro pyran. These substances exhibit phototropy in the crystalline state, being colourless in the dark but becoming violet in the light. Each substance has a different time-variation and a brief discussion is given of the structural connection with the phototropic property. H. H. Ho.

1108. Intensive Drying. A. Smits. *Zeits. f. phys. Chem.* 28. *Abt.B.* 1. *pp.* 31–42, 1935.—Reference is made to the work of Bodenstein and Baker. Exception is taken to the view expressed by Bodenstein that those gas reactions which are stopped by drying are chain reactions. A reaction can be stopped in two ways; namely, by the removal of the last trace of water and secondly, as pointed out by Bodenstein, by the presence of a foreign body. Chain reactions are sensitive to both these influences. It would appear that as the photochemical reaction between H_2 and O_2 is not a chain reaction it would not be influenced by drying in accordance with the views of Bodenstein. However, Baker found that this reaction was slowed down by drying. This paper also reviews the results obtained by many workers which appear to contradict the results of Baker. A suggestion based on molecular activity is made to explain the contradictory results obtained. J. K.

1109. Restoration and Reproduction Power of Developable and Fixable Bleached-Out Dyed Photographic Layers. G. Ungar. *Zeits. f. wiss. Phot.* 33. *pp.* 177–190, *Dec.*, 1934.—Describes the results of experiments on the restoration of developable bleached-out dyed photographic layers by the silver salts of organic dyes, two methods being given whereby fixable bleached-out pictures are obtained. Using dyes which cannot be washed out of the gelatin no intensification of the light action is obtained during development. This is due to the splitting up of the dye-silver molecules by light, but by suitable treatment of the primary silver image a bleached out picture is obtained which can be made permanent by fixing. Using dyes capable of removal by washing the action of the light can be intensified, the silver picture being obtained by using an organic developer in an alkaline solution and the free dye removed by washing. In such layers the unchanged dye silver salt must be changed into an insoluble dye salt before fixing, this being done simultaneously with the removal of the separated silver by a cupric chloride solution. With direct treatment the sensitivity of the dye silver salts is dependent upon the constitution of the dyes used, but this constitution is unimportant if a development process is used. In only one case, with development treatment, is the Grotthus-Draper law satisfied. [See also Abstract 4520 (1934).] R. C. F.

***1110. Timing Device for Motion Pictures. G. Zechel and O. orgenstern.** *Science*, 81. *pp.* 23–24, *Jan.* 4, 1935.—The study of any morphological state attains its full value only when a record is taken of the stages which precede and follow it. The authors describe an apparatus which automatically operates a motion picture camera so that single exposures are taken in adjustable intervals from 1 sec. to 10 min., switching on the light source just before exposure and off again immediately the photograph is taken in order to preserve the living object. The equipment consists of a motor-driven impulse transmitter transmitting one impulse to light the lamp and one impulse to a tripping magnet which when energised presses the release button of the camera for *one* picture. Naturally the impulse for lighting the lamp must be transmitted just before the exposure impulse so that on exposure the lamp is at full brightness. R. C. F.

1111. Problems and Progress in Photography. O. Bloch. *Nature*, 135. *pp.* 89–92, *Jan.* 19, 1935. *Course of* 3 *lectures delivered at the Roy. Inst., Oct. and Nov.*, 1934.—After briefly considering the widely different requirements for astronomy, work with α-particles and protons, and work with atomic rays and in the extreme ultra-violet, the present author then discusses the internal problems of the subject. The points considered are the complex functions of gelatin in emulsion making, the action of light on the silver halides including the effect of S compounds in the gelatin, development, mode of expressing speed, resolving power, graininess, and finally optical sensitising. R. C. F.

See also Abstracts 1134, 1204, 1276.

PHOTOMETRY.

***1112. Sensitivity of Light Counters. M. W. Karev and S. F. Rodionov.** *Zeits. f. Physik*, 92. 9–10. *pp.* 615–621, *Dec.* 7, 1934.—A light counter (Geiger counter actuated by photoelectrons) is described suitable for the measurement of very small light intensities. The number of discharges of the counter per incident light quant was determined for wave-lengths ranging from 254 to 435 $m\mu$, and compared with the normal photoelectric current from the kathode when the counter was used as a photoelectric cell. It was found that the light counter either responded only to a small fraction of the total number of photoelectrons emitted or alternatively that the discharges in the counter reduced the emission from the kathode. W. S. S.

1113. Statistic of the Impulses of a Photon Counter in the Region of Ultra-Violet Light. A. Kolin. *Ann. d. Physik,* 21. 8. *pp.* 813–831, *Jan.,* 1935.—The registration of radioactive radiation in the "dark effect" with the photon counter occurs with great approximation statistically. The first impression of group discharges proves to be illusion. The registrations of light, however, proceed unstatistically, while the small impulse intervals occur less frequently than indicated by theory, so that the curve maximum is shifted towards greater values of the impulse interval. The shape of all curves can be explained by the assumption of a rise of the egress work after each impulse. J. J. S.

***1114. Greinacher Hydraulic Counter for Quanta and Ionising Particles. R. D. Summers.** *Rev. Sci. Instruments,* 6. *pp.* 39–40, *Feb.,* 1935.—A modified form of Greinacher counter [see Abstract 4138 (1934)] is described with an auxiliary ionisation gap to extend the frequency range. This sensitive detector of faint radiation and ionising particles can be easily and quickly assembled from common and inexpensive parts. AUTHOR.

See also Abstracts 1119, 1134.

POLARISATION.

1115. Anisotropy of Liquid Surrounding Gas Bubbles. P. Gaubert. *Comptes Rendus,* 200. *pp.* 304–306, *Jan.* 21, 1935.—When gas bubbles immersed in a liquid touch, a birefringent layer becomes evident along the line of contact. Nothing is visible around a single bubble owing to the largeness of the refractive index difference. The anisotropy is due to a layer of liquid, whose birefringence is negative, existing around all bubbles. A. S. C. L.

1116. Convergent Polarised Light and Hertz' Problem for a Uniaxial Material. F. F. P. Bisacre. *Phys. Soc., Proc.* 47. *pp.* 306–322, *March* 1, 1935.—The paper gives a mathematical treatment of the behaviour of convergent polarised light passing through a uniaxial crystal, together with some practical details relating to the production of rings and brushes. The Fresnel wave surface is shown to be the isophasic for a system of waves diverging from a point source in the crystal. AUTHOR.

1117. Polarimetric Methods in Chemistry. T. M. Lowry. *Nature,* 134. *pp.* 920–921, *Dec.* 15, *and pp.* 958–960, *Dec.* 22, 1934. *Abstract of Presidential Address to British Assoc., Aberdeen, Sept.,* 1934.—The abstract deals mainly with (i) *mutarotation,* or change of rotatory power with time, *e.g.,* in freshly-prepared aqueous solutions of a reducing sugar, or in solutions of nitrocamphor in organic solvents, (ii) *rotatory dispersion,* both in transparent media and in a region of weak selective absorption, where the "Cotton effect" is observed. The origin of mutarotation is discussed, and the conditions under which it takes place are described, and an account is given of the phenomena of *dynamic isomerism* or reversible isomeric change and of *prototropy* or the reversible migration of a proton between alternative positions in the molecule, which are the most frequent causes of mutarotation. The classification of rotatory dispersions as (i) *normal* and *anomalous* and (ii) *simple* and *complex* is described, and an account is given of the phenomenon of *induced dissymmetry*, whereby a chromophoric group becomes optically active when coupled sufficiently closely to a centre of fixed asymmetry, *e.g.*, an asymmetric carbon atom. T. M. L.

1118. Rotatory Power of Quartz for Rays Perpendicular to the Optical Axis and its Dispersion in the Ultra-Violet. G. Bruhat and P. Grivet. *J. de Physique et le Radium*, 6. *pp.* 12–26, *Jan.*, 1935.—By photoelectric analysis a study was made of the vibrations transmitted by a plate of quartz parallel to the axis for incident rectilinear vibrations near the optical axis or the perpendicular direction. The complete analysis of the transmitted elliptical vibrations was made for the different radiations of the mercury arc comprised between 4358 and 3021 Å, and the measurements were continued to 2537 Å when confined to the determination of the orientations of the axes. Seven plates of quartz were examined of thicknesses varying from 169 μ to 2 mm. The measurements show that the phenomena are well represented by the hypothesis that the privileged vibrations in the quartz for rays perpendicular to the axis are two inverse elliptical vibrations. The different plates all give the same absolute values for the ellipticity of these vibrations, on condition of taking account for the thick plates, by special measurements, of the fact that the radiations isolated by the monochromator are not perfectly monochromatic. The values of the ratio B/A of the privileged vibrations are given by the angle ϵ defined by the relation tau $\epsilon/\lambda = B/A$. The angle ϵ varies almost inversely as the wave-length, and changes from 19′ for $\lambda = 4358$ Å to 38′ for $\lambda = 2537$ Å. Quartz exhibits for rays perpendicular to the axis a rotation ϕ defined by $2\rho = \phi$ tau ϵ. It was compared for four plates of quartz, right and left, with the rotation ρ_0 for rays parallel to the axis, and was always found opposed to this last. For all the radiations the ratio ρ/ρ_0 is approximately equal to $-0{\cdot}53$. It does not differ from this mean value except by quantities lower than the errors of measurement. J. J. S.

See also Abstracts 979, 1103.

RADIATION, EMISSION.

***1119. Theory of the A.C. Bolometer. P. Moon.** *Frank. Inst., J.* 219. *pp.* 17–36, *Jan.*, 1935.—In using d.c. thermocouples and bolometers to measure small amounts of radiant energy difficulties arise owing to spurious e.m.f.s and the high sensitivity galvanometer required. These disadvantages can be overcome by using a.c. and a suitable amplifier. Harris [see Abstract 2560 (1934)] has described how thermocouples can be used in this way. The present paper considers the advantages obtained by operating a bolometer from an a.c. source. A simple a.c. bridge circuit is described in which the resistance of the bolometer strip has no effect on the detector, and bolometer wires of extremely high resistance can be used to advantage. A theory is developed for a vacuum target bolometer when used in such a circuit and applied to give data for the design of sensitive bolometers of this type. Such bolometers should readily detect radiation of 5×10^{-9} watt per cm.^{2}, and it should be possible to use multi-target bolometers. It is concluded that the a.c. bolometer compares favourably with the best radiometric instruments available and is simpler to use.

R. W. P.

1120. Transfer of Modulation in the Heaviside Layer. Y. Rocard. *Comptes Rendus*, 199. *pp.* 1601–1603, *Dec.* 26, 1934.—The improved reception at Saigon by increasing the effective current at the base of the aerial at Croix d'Hins from 500 to 700 Å may be explained by an apparent change of the dielectric constant in the Heaviside layer due to the greater velocity of the electrons under the influence of the transmitted wave and the increased impacts per sec. against molecules. Calculations show that the mean value of the dielectric constant, for a given frequency, depends on all the transmitted waves, of the same or different frequencies. It is, moreover, modulated by the beatings or direct modulations of these different waves. The intensity of reception cannot be proportional to the emission intensity when the variations of the effective dielectric constant under the influence of the wave itself have a critical character, as in the passage from the régime of long to short waves; also it depends on the power of other transmissions, and certain "fading" phenomena may be due to this cause. The transfer of modulation from one carrier wave to another arises from this modulation of the dielectric constant. The feature noted by van der Pol and van der Mark, that the depth of the transferred modulation should be less the higher the modulation frequency, cannot, however, be explained immediately by the theory here given and demands a closer study of the modification of the Heaviside layer by an incident wave and of the time-constant of the transformation into thermal energy of the energy imparted to the electrons by the wave. The view of Ionescu and Mihul that in an ionised gas the free electrons are not in thermal equilibrium must also be considered. A. W.

1121. Ionosphere Investigations Conducted at College—Fairbanks, Alaska, during the Winter of 1933-4. J. A. Fleming. *Terr. Mag.* 39. *pp.* 305–313, *Dec.*, 1934.—Results are given of the continuance during the winter 1933–4 of the ionosphere investigations begun at Fairbanks, Alaska, during the Second International Polar Year. The modified equipment is described and subsequent to February 10, 1934, it was moved to College, Alaska, and further modified for side-by-side operation. A typical record is given of the continuous automatic registrations of the ionosphere virtual height (h) on a frequency of 2050 kc. Tabulated values of h show that during the morning, following the appearance of the critical frequency, h falls rapidly to an average value of about 210 km., identifying the layer returning reflections on this frequency as the F-layer. The periods during which reflections are returned and the times of critical frequency are shown. The usual morning increase of ionisation is associated with sunrise and it is deduced that the ionising rays of the sun must be absorbed below a certain limit in the atmosphere when they are directed parallel to the earth's surface. The decrease in ionisation in the afternoon is associated with time of sunset but is not so regular. Reflections are observed most frequently near sunrise and sunset indicating increased absorption near noon. The E-layer reflections are seldom observed and then only at night, indicating that the maximum ionisation of the E-layer is not sufficient to prevent penetration on 2050 kc. Comparison of the ionosphere data and the College magnetic records is made. Magnetic disturbances usually occur at night. There was a strong tendency for the usual morning reflections to fail to appear during or following a magnetic disturbance. Records obtained, show a striking improvement in their character with side-by-side operation. R. S. R.

1122. Amplitude Variations of Downcoming Radio Waves. J. L. Pawsey. *Cambridge Phil. Soc., Proc.* 31. *pp.* 125–144, *Jan.*, 1935.—Experiments are described for measuring the lateral deviation of radio waves after reflection from the E- and F-regions of the ionosphere. It was found that the greatest lateral deviation observed, 20° or more, was that due to the *e*-region, and the least, about 0·5°, was due to the normal E-region in the case of a distant transmitter. The time variation of amplitude of a reflected wave was found to be consistent with a random scattering at the ionosphere. In the theoretical discussion it is shown that changing horizontal irregularities, ion clouds, are a very important cause of fading. Values are calculated for the average fading periods which would result from the horizontal winds in the neighbourhood of the E-region known to exist from other evidence. These calculated periods agree with the observed and it is inferred that horizontal winds are a very important cause of fading. AUTHOR.

1123. Ionisation Charts of the Upper Atmosphere. Part II. G. Millington. *Phys. Soc., Proc.* 47. *pp.* 263–276, *March*, 1935.—This paper discusses an envelope correction to some ionisation charts previously published, and in addition presents the new charts on a circular projection to help in the study of conditions in the polar regions. [For Part I see Abstract 5156 (1932).] AUTHOR.

1124. Angular Distribution of Cosmic Rays at Sea Level. W. Kolhörster and L. Jánossy. *Zeits. f. Physik*, 93. 1–2. *pp.* 111–122, *Dec.* 17, 1934.—The angular distribution of cosmic radiation was determined by coincidence measurements using two counters much closer together than usual. This arrangement was chosen as the effect of casual coincidences is reduced. The distribution is calculated from the experimental results using Jánossy's theory, which is outlined. The distribution curve is steep over the range 20°–70° from the zenith, but varies more slowly outside this range. In the horizontal direction an intensity 4 % of that in the vertical direction is obtained; this is attributed to scattered radiation, rather than to horizontally incident radiation. The curve indicates, to a first approximation, a $\cos^2$-distribution. Intensity measurements are determined in absolute units and values are given for specific ionisation and other constants of the radiation. D. H. F.

1125. Cosmic Ray Coincidence Measurements. P. Auger and P. Ehrenfest. *Comptes Rendus*, 199. *pp.* 1609–1611, *Dec.* 26, 1934.—Experiments were carried out with four counters arranged in a vertical plane, two above and two below a block of lead 50 cm. thick. A Wilson chamber operated by the discharge of the counters was placed first between the upper two counters and afterwards between the lower two. In each case it was found that for about 80 % of the coincident discharges of the four counters a single vertical straight track through the cloud chamber was photographed. Hence it is concluded that the coincidences are due to a single corpuscle capable of penetrating 50 cm. of lead, in opposition to the opinion of Millikan that coincidences under these conditions are due largely to showers and photons. D. H. F.

1126. Equatorial Longitude Effect in Cosmic Rays. R. A. Millikan and H. V. Neher. *Phys. Rev.* 47. *pp.* 205–208, *Feb.* 1, 1935.—Observations taken with recording electrometers on a number of voyages where the equator was crossed at different parts of the world showed that the variation in cosmic ray intensity between magnetic latitude 42° and the equator (" latitude effect ") is about 8 % when the equator is crossed near Peru and about 12 % when it is crossed near Singapore on the other side of the world. At an intermediate longitude it is 10 %. The difference in the horizontal magnetic component at different parts of the equatorial belt is thus presumed to manifest itself in the regions above the earth's surface where the cosmic rays first come under the influence of the earth's magnetic field. It was found that if the point 78° N, 69° W was taken as the pole, readings taken all round the globe remain nearly the same for the same latitude as measured from this point. D. H. F.

See also Abstracts 1085, 1097, 1098, 1113, 1131, 1233.

RADIATION, GENERAL THEORY.

1127. New Type of Expansion in Radiation Problems. W. W. Hansen. *Phys. Rev.* 47. *pp.* 139–143, *Jan.* 15, 1935.—A new type of expansion of $\mathrm{i}(1)e^{ikr_{12}}/r_{12}$ is developed. Here i is a vector function of the spherical coordinates denoted by 1 and r_{12} is the distance between two points denoted by 1 and 2. This expansion is used in the solution of Maxwell's equations and a simple general expression is found for the energy radiated from a known current distribution. A brief application to Dirac's theory of radiation is given. An expansion for $\mathrm{i}(1)/r_{12}$ is developed which can be used to find the vector potential due to a steady current distribution. AUTHOR.

1128. Heterogeneous Electromagnetic Ether Capable of Producing a Quantum Atomic Force Field. M. Brillouin. *Comptes Rendus,* 200. *pp.* 275–279, *Jan.* 21, 1935.—The consequences of the assumption that the central nucleus renders the adjacent Maxwell's ether heterogeneous, and that to this resulting state of the ether is due the quantum atomic force field, is developed on the basis of classical mechanics. [See Abstract 715 (1935.] N. M. B.

See also Abstracts 1004, 1113, 1141.

REFLECTION. REFRACTION AND DISPERSION.

1129. Physical Properties of the Alkyl Compounds of Mercury, Tin and Lead. W. J. Jones, D. P. Evans, T. Gulwell and D. C. Griffiths. *Chem. Soc., J. pp.* 39–47, *Jan.,* 1935.—The preparation of a number of alkyls of Hg, Sn and Pb is described and the following physical data listed: density and molecular volume at 20°; refractive indices at 20° for C, D and F lines, and the corresponding molecular and atomic refractivities. Some heats of combustion and of formation are also included. A. S. C. L.

1130. Refractive Index of Vitreous Silica and Calibration of Silica Refraction Thermometers between 18° and −200° C. J. B. Austin and R. H. H. Pierce, Jr. *Physics,* 6. *pp.* 43–46, *Jan.,* 1935.—The variation with temperature of the refractive index of fused silica for the helium line 5877·2 Å has been determined between 18° and −200° C. and the results have been applied to the calibration of vitreous silica refraction thermometers at low temperatures. These data have been correlated with measurements at high temperatures. It is found that the refractive index between −200° C. and 1000° C. can be represented by the equation $n = 1{\cdot}45657 + 0{\cdot}001553\, t/100 + 0{\cdot}00219\, e^{-0{\cdot}33t/100}$. AUTHORS.

***1131. Ultra-Violet Microscope Illuminator, and Its Application to the Study of Rayon. T. H. Daugherty.** *Univ. Pittsburgh, Bull.* 31. *pp.* 66–70, *Oct.*, 1934.—A new mercury arc has been devised which, by its annular construction, irradiates a specimen by causing a cone of ultra-violet rays to impinge upon it. The elimination of shadows causes a full illumination. The fact that the arc nearly surrounds the object and is very close to it results in a very satisfactory intensity. A depth of focus insures examination of relatively thick specimens without refocussing. By using suitable filters, this arc may be used for the identification of the commercial types of rayon. The previously reported contradictory results have been largely eliminated by recording results obtained with a variety of specified filters, and with authentic samples from known sources. Also, the colours obtained microscopically can be duplicated macroscopically except those of structures invisible to the naked eye. AUTHOR.

***1132. Performance of the Projection Microscope. A. Köhler.** *Naturwiss.* 23. *pp.* 27–35, *Jan.* 11, 1935.—A discussion of the magnification produced by optical instruments with particular reference to the projection microscope. C. B. A.

***1133. Optical Invertor. L. Lumière.** *Comptes Rendus*, 200. *pp.* 281–283, *Jan.* 21, 1935.—A simple invertor, consisting of a totally-reflecting prism cemented to a face of one of pentagonal section is described. C. B. A.

***1134. Optical Apparatus and Methods of Measurement. Part I. F. Jentzsch and H. Funk.** *Die Physik*, 3. 1. *pp.* 31–56, 1935.—A summary of developments in optical instruments and technique during 1930–1933, covering light-sources and filters, photometry and colour measurement, spectroscopic apparatus, measurements of reflection, refraction, absorption and scattering, optical materials, microscopes and telescopes, projection, photography, and a discussion of the advantages of using simultaneous electrical and optical methods. Numerous references to original papers are given. C. B. A.

See also Abstracts 974, 1067, 1115, 1192.

SPECTROSCOPY.

1135. Interference Measurement in the Infra-Red Arc Spectrum of Iron. W. F. Meggers. *Bureau of Standards, J. of Research*, 14. *pp.* 33–40, *Jan.*, 1935.—Wave-lengths of the stronger infra-red radiations characteristic of integrated light from an iron arc at atmospheric pressure are measured relative to neon standard by the Fabry-Perot interferometer method. Values are given for 91 lines ranging from 7164·469 to 10216·351 Å. Spectral term combinations indicate that most of these lines require relatively high excitation energies, which account for their character and properties. Differences between values from integrated arc light at atmospheric pressure and from the vacuum arc are interpreted as pressure- and Stark-effects. It is suggested that the international system of secondary standards of wave-length can be extended into the infra-red by using integrated light from an iron arc at 1 atmosphere pressure. AUTHOR.

1136. Absorption Series in Argon, Krypton and Xenon from Terms below the Two Ionisation Limits $^2P^0_{3/2}$ and $^2P^0_{1/2}$. H. Beutler. *Zeits. f. Physik*, 93. 3–4. *pp.* 177–196, *Jan.* 4, 1935.—The absorption spectra of A, Kr and Xe are photographed between 1070 and 600 Å against the He continuum, the gas streaming through the vacuum spectrograph at pressures from 0·03 to 0·001 mm. The main absorption in this region is found to lead to the excitation of un-sharp terms lying between the two levels ${}^2P^0_{\frac{3}{2}}$ and ${}^2P^0_{\frac{1}{2}}$. The continuous absorption above ${}^2P^0_{\frac{1}{2}}$ is much weaker and that in the discrete terms below ${}^2P^0_{\frac{3}{2}}$ is quite faint. This agrees with the constants of the dispersion formula as deduced from the refraction in the visible spectrum. The new terms form series converging to ${}^2P^0_{\frac{1}{2}}$, two such series being found in each of Kr and Xe. In A they overlap. The more intense and diffuse of these series is found to contain the lines $(p)^6\ {}^1S_0 \rightarrow (p)^5_{\frac{1}{2}}$ *md*, the weaker and sharper series the lines $(p)^6\ {}^1S_0 \rightarrow (p)^5_{\frac{1}{2}}$ *ms*. Some of these terms were already known in the discrete spectrum below ${}^2P^0_{\frac{3}{2}}$; in absorption they are only feebly excited. The intensity of absorption increases several hundred times as the limit ${}^2P^0_{\frac{1}{2}}$ is passed, when the possibility of the decomposition of terms $(p)^5_{\frac{1}{2}}$ *ml* into an ion ${}^2P^0_{\frac{3}{2}}$ and an electron begins. The 38 new lines are tabulated in detail. C. B. A.

1137. Spectra of Lead IV and Bismuth V. G. K. Schoepfle. *Phys. Rev.* 47. *pp.* 232–234, *Feb.* 1, 1935.—Early investigations in the spectra of Pb IV by Rao and Narayan, Smith and Kishen have been extended to include 34 terms arising from the configurations $5d^{10}ns$, $5d^{10}np$, $5d^{10}nd$, $5d^{10}5f$, $5d^9 6s^2$, $5d^9 6s6p$ and $5d^9 6s6d$. With data by Arvidsson, Smith and the author, the region reported extends from 198 to 5005 Å and 79 lines have been classified. In the extension to Bi V, values have been assigned to 14 terms involving 18 lines in the region below 1487 Å. By a Hick's formula the value of the $5d^{10}6s\ {}^2S_{0\frac{1}{2}}$ term has been computed to be 340,885 cm^{-1}. for Pb IV and 451,700 cm^{-1}. for Bi V, giving ionisation potentials of 42·0 and 55·7 volts, respectively. AUTHOR.

1138. Classification of the First Spark Spectrum of Lead : Pb II. L. T. Earls and R. A. Sawyer. *Phys. Rev.* 47. *pp.* 115–122, *Jan.* 15, 1935.—The spectrum of Pb II as excited in a Schüler, hollow kathode discharge in helium has been photographed in the region from 800 Å to 10,000 Å. With these data the classification given by H. Gieseler [see Abstract 2293 (1927)] has been corrected and extended. 247 lines have been classified, which locate 89 levels below the ionisation level of the ion. These include the *s*, *p*, *d*, *f* and *g* series based on $6s^2$, extending to values of *n* of from 14 to 19, and all levels of the other configurations which are expected below ionisation. The assignment of these levels is checked by series considerations, by Zeeman effect data, by hyperfine structure data, by comparison with the similar spectra Ge II and Sn II, and by the agreement with the regular and irregular doublet laws in the isoelectronic sequence with Tl I and Bi III. The anomalous location of a number of the levels is explained qualitatively by the perturbations expected between the even levels. [See following Abstract.] AUTHORS.

1139. Hyperfine Structure of Singly Ionised Lead. J. L. Rose. *Phys. Rev.* 47. *pp.* 122–128, *Jan.* 15, 1935.—Some 130 lines of Pb II were observed with Lummer-Gehrcke plates and Fabry-Perot interferometers from 2300 to 10,000 Å. The isotope shifts between Pb^{208} and Pb^{206}, and the hyperfine structure splitting of Pb^{207} were computed from the hyperfine structure measurements of these lines for all of the levels of Pb II, classified by Earls and Sawyer [see preceding Abstract], with the exception of $6s^2 6p\ {}^2P_{1/2,\ 3/2}$ and $6s6p^2\ {}^2P_{1/2}$. Parameters were obtained for equations derived by Breit and Wills for finding the hyperfine structure constants, a', a'', a''', and $a(s)$, of the $6s6p^2$ configuration in intermediate coupling. AUTHOR.

1140. Hyperfine Structure of the Resonance Lines of Potassium. D. A. Jackson and H. Kuhn. *Roy. Soc., Proc.* 148A. *pp.* 335–352, *Feb.* 1, 1935.—The hyperfine structure of the resonance lines of K is investigated by means of absorption of an atomic beam. The atomic beam is produced by evaporating K through a cool tube whose length is twenty times its width. The absorption of this beam for the light from a K–Ne h.f. discharge lamp is observed at right angles to the direction of the beam by means of a spectrograph combined with a Fabry-Perot étalon .The étalon is of entirely new design, the plates being held 10 cm. apart by separating pieces of fused silica worked to the highest degree of optical accuracy. Each of the resonance lines of K 7699 Å and 7664 Å is found to consist of two components of nearly equal intensity the separations being $0\cdot0163$ cm^{-1} and $0\cdot0141$ cm^{-1} respectively; the separation of the $4S_{\frac{1}{2}}$ term is $0\cdot0152$ cm^{-1}. It is concluded that the nuclear mechanical moment of the K isotope 39 is greater than 3/2, that the nuclear magnetic moment lies between $0\cdot43/1838$ and $0\cdot47/1838$ Bohr magneton and is probably of opposite sign to the mechanical moment. By altering the angle of observation it is found possible to measure directly the Doppler effect due to the velocity of the atoms in the beam. The mean velocity of the atoms is found to be 650 m. per sec.; this is the theoretical gas-kinetic value. The hyperfine structure of the sodium resonance lines is similarly measured and the nuclear moment deduced from the measurements is $2\cdot05/1838$ Bohr magneton.

J. E. K.

1141. Electromagnetic Fields due to Variable Electric Charges and the Intensities of Spectrum Lines according to Quantum Theory. C. E. Easthope. *Roy. Soc., Proc.* 148A. *pp.* 453–470, *Feb.* 1, 1935.—The intensities of spectrum lines for H and H-like atoms with Schrödinger distributions are investigated by Schott's method [see Abstract 1645 (1933)] for calculating the electromagnetic fields due to a variable electric charge, avoiding the assumption that a spatially extended distribution can be treated as if its electric moment were concentrated in a point. Results for the radiation from a fixed H atom with any axiosymmetrical distribution establish the fact that, when the frequency of the emitted radiation is such that $(2\pi\nu/\gamma)^2$ can be neglected in comparison with unity, the method of quantum theory for estimating intensities of spectrum lines, although based on an unsatisfactory assumption, does give the correct results. This condition is satisfied for all the common series in optical spectra; thus the accuracy of quantum results depends only on the frequency of the emitted radiation, and not on the magnitude of the principal quantum numbers. For higher frequencies such as X-rays, for which it is possible to neglect only powers of $(2\pi\nu/\gamma)$ above the square, it is proved that the classical formula gives too great an intensity value. The values of the % error, calculated for various spectrum lines for a number of elements, show that the error, although increasing with the atomic number, is always small and decreases as the principal quantum numbers increase, which is in accordance with Bohr's correspondence principle. N. M. B.

1142. Far Infra-Red Absorption of Benzene. R. B. Barnes, W. S. Benedict and C. M. Lewis. *Phys. Rev.* 47. *pp.* 129–130, *Jan.* 15, 1935.—The absorption of benzene has been studied from 40–135μ under high resolution. Five weak bands, interpreted as difference bands, have been found in the liquid. The observations lend strong support to the plane symmetrical hexagonal model for benzene. AUTHORS.

1143. Light Absorption and Association of Cadmium, Zinc and Copper Halides in Aqueous Solution. E. Doehlemann and H. Fromherz. *Zeits. f. phys. Chem.* 171. *Abt.A.* 5–6. *pp.* 353–378, 1934.—The absorption spectra of various halogen salts of Cd, Zn and Cu in aqueous solution, both alone and when mixed with the corresponding salts of Li, K or Ca, and with each other, are recorded. In concentrated solutions and in an excess of alkali halide the Cd salts exhibit absorption bands which are attributed to coordination complexes. These bands become weaker and move towards shorter wave-lengths on dilution, corresponding with the formation of association complexes poorer in halogen, which then break up into Cd and halogen ions. ZnI_2 behaves like the Cd halides. $ZnBr_2$ shows weak association, but $ZnCl_2$ behaves entirely as the alkali or alkaline earth halides. The zinc salts thus form a transition class. The degree of association in all these cases is estimated. The tendency to form coordinated complexes increases in the order Zn, Cd, Hg and Cl, Br, I. The maxima of absorption show corresponding regularities. $CuCl_2$ and $CuBr_2$ in an excess of alkali halide also form coordination complexes. At halogen concentrations above 2 mol./l., the absorption spectra change in character, and suggest the presence of larger complexes. Mixtures of cupric and cuprous halides in the presence of alkali halides are also studied. C. B. A.

1144. Absorption of Light by Porphyrins. W. Herold. *Zeits. f. phys. Chem.* 171. *Abt.A.* 5–6. *pp.* 463–464, 1934.—It is pointed out that, contrary to the statement of Stern and Wenderlein [see Abstract 5045 (1934)] dioxan cannot be treated as a non-polar solvent, and that polar solvents may have advantages in some cases when molecular configuration is in question. C. B. A.

1145. New Absorption Spectrum of Diatomic Sulphur Vapour in the Schumann Region. K. Wieland, M. Wehrli and E. Miescher. *Helv. Phys. Acta,* 7. 8. *pp.* 843–849, 1935. *In German.*—In superheated sulphur vapour, at pressures from below 1 mm. upwards and a column length of 5 cm., new absorption bands are observed between 1600 and 1870 Å. They belong to the S_2 molecule [see Abstract 1179 (1934)]. The bands, which are shaded towards shorter wave-lengths, can be divided between at least two electron systems, for which formulæ can be derived. C. B. A.

1146. Absorption Spectra of Complex Salts in Different Solvents. R. Samuel and M. Uddin. *Faraday Soc., Trans.* 31. *pp.* 423–432, *Feb.,* 1935.—Absorption spectra of hex- and pent-ammino cobaltic chlorides, pent-ammino nitro cobaltic sulphate, sodium nitroprusside, sodium rhodihexachloride, and potassium platino tetrachloride dissolved in water and in aqueous solutions of NaCl, KCl, K_2CO_3, Na_2CO_3, Na_2SO_4, and KBr are recorded, and the displacements of the maxima relative to those for the water solution which are observed in the salt solutions are discussed in the light of the possibility of a molecular Stark effect and of the deformation of the complex molecule. C. B. A.

1147. Ultra-Violet Absorption Spectra of the Stannic Halides in Various Solvents. Margaret I. Grant. *Faraday Soc., Trans.* 31. *pp.* 433–440, *Feb.,* 1935.—The absorption spectra exhibited by stannic iodide in solution in hexane, ethyl and methyl alcohols, and in mixtures of ethyl alcohol and hexane are described and discussed. Stannic bromide in hexane and in ethyl alcohol, and stannous bromide in methyl alcohol were also examined. A difference in the behaviour of stannic iodide is observed and an explanation suggested. C. B. A.

1148. Absorption Spectrum of NaD. E. Olsson. *Zeits. f. Physik,* 93. 3–4. *pp.* 206–219, *Jan.* 4, 1935.—The band spectrum of NaD has been measured and analysed. The true quantum numbers in NaD and NaH are determined by use of the isotope effect. An influence of the electrons on the nuclear vibration and rotation observed and interpreted in AlH/AlD by Hulthén and Holst is also present in NaH/NaD. The isotope effect in the excited state is quite normal, which is striking in view of the anomalous energy relationships in the nuclear vibration and rotation. **Errata.** *ibid.* 93. 11–12. *p.* 816, *Feb.* 26, 1935. C. B. A.

1149. Spectrum of AsO. F. A. Jenkins and L. A. Strait. *Phys. Rev.* 47. *pp.* 136–139, *Jan.* 15, 1935.—The band-heads of two systems due to AsO have been measured, and the following equations deduced as the best representation of the vibrational structure

$$\text{A: } \nu = \begin{Bmatrix} 31{,}655\cdot 8 \\ 30{,}631\cdot 1 \end{Bmatrix} + 683\cdot 8(v'+\tfrac{1}{2}) - 9\cdot 42(v'+\tfrac{1}{2})^2 - 966\cdot 6(v''+\tfrac{1}{2}) + 4\cdot 92(v''+\tfrac{1}{2})^2$$

$$\text{B: } \nu = \begin{Bmatrix} 39{,}862\cdot 0 \\ 38{,}838\cdot 3 \end{Bmatrix} + 1098(v'+\tfrac{1}{2}) - 6(v'+\tfrac{1}{2})^2 - 966\cdot 6(v''+\tfrac{1}{2}) + 4\cdot 92(v''+\tfrac{1}{2})^2.$$

The intensity distribution in system A is normal, but in system B the $v' = 0$ progression is predominant. This is explained by predissociation, and a value of 4·93 volts is found for the heat of dissociation of AsO.

AUTHORS.

1150. Band Spectrum of Barium Hydride at 10,000 Å. W. W. Watson. *Phys. Rev.* 47. *pp.* 213–214, *Feb.*, 1, 1935.—A BaH band with principal head at 10,052 Å degraded to the red is $(0,0)^2\Pi_{1\frac{1}{2}} \rightarrow {}^2\Sigma$, the lower state being the same as for the other BaH systems. $B_0{}^* = 3\cdot 280$, $D_0 = -1\cdot 3 \times 10^{-4}$ and the Λ-doubling is large and negative. This ${}^2\Pi$ state as well as the upper ${}^2\Sigma$ state for the 8924 Å band must be derived from Ba ${}^3P$ + H ${}^2S$. The origin of a perturbation in the ${}^2\Pi_{1\frac{1}{2}c}$ levels at $J = 20\frac{1}{2}$ is discussed. [See Abstract 1494 (1933).] AUTHOR.

1151. Ultra-Violet Absorption Band of Li_2. J. E. Vance and J. R. Huffman. *Phys. Rev.* 47. *pp.* 215–216, *Feb.* 1, 1935.—Ultra-violet band systems of lithium have been observed and a vibrational analysis suggested which involves four upper states. Assuming that these upper states have the same dissociation limit, values of D′ have been calculated and compared with corresponding values of D′ for the upper states of sodium. AUTHORS.

1152. Temperature Variation Method to Assist in Vibrational Analyses of Complex Molecular Spectra. J. H. Clements. *Phys. Rev.* 47. *pp.* 220–224, *Feb.* 1, 1935.—A temperature variation method of determining the initial (lower) vibrational levels of the absorption bands of an electronic band system of a polyatomic molecule is presented. The determination is made from photometric measurements of the absorption at two temperatures not widely separated. Such absorption tube lengths are used that the absorption is everywhere much less than 100 % in the bands to be studied. That variations in total absorption for a band may be measurable, the method is restricted to spectra in which the rotation lines are fairly broad compared with the intervals between them or else are very closely spaced. In such cases the rotational structure is blotted out on the photographic plate by the lack of resolution of the spectrograph and the exponential absorption law may be assumed in comparing absorption intensities at the two temperatures. A criterion is laid down for the applicability of the method in any instance. An equation is developed to give the heights (in cm.$^{-1}$) of the excited vibrational levels of the normal electronic state involved in the various transitions, above that of some arbitrarily selected band of a group, as follows: $\log_{10}\rho_b/\rho_a = -0{\cdot}623\ (1/T_2 - 1/T_1)\ (G_b - G_a)''$. The determination of the heights $(G_b - G_a)''$ in cm.$^{-1}$ comes from the two absolute temperatures and the ratio ρ_b/ρ_a of the heights of the absorption peaks on the two microphotometer traces. AUTHOR.

1153. Absorption Spectrum of Sulphur Dioxide. J. H. Clements. *Phys. Rev.* 47. *pp.* 224–232, *Feb.* 1, 1935.—An attempt to organise the absorption bands of SO_2 in the region 3900–2600 Å has been made. The (000)″ — (000)′ transition 3129·5 Å (31,945 cm.$^{-1}$) has been definitely located from a study of the temperature behaviour of the lower frequency bands. Two of the vibrational frequencies known in the normal state have been observed and the intervals between successive lower levels determined. One of the frequencies in the excited state has been definitely assigned and a tentative value has been assigned for a second frequency. The configuration of the excited molecule is discussed. AUTHOR.

1154. Band Spectrum of Nickel Hydride. Bands at λ 5713, λ 6246 and λ 6424. A. G. Gaydon and R. W. B. Pearse. *Roy. Soc., Proc.* 148*A*. *pp.* 312–334, *Feb.* 1, 1935.—Bands with very open structure have been observed at λ 5713, λ 6246 and λ 6424 in the spectrum obtained by introducing nickel carbonyl into the flame of a Meker burner. They are attributed to NiH. This assignment has been confirmed by the production of the bands in other sources containing nickel and hydrogen. The bands have been photographed in the first order of a 10-ft. concave grating with exposures up to 12 hr. Analysis of the bands showed that they consisted of P, Q and R branches with a number of missing lines consistent with a transition of the type $^2\Delta_{2\frac{1}{2}} \rightarrow {}^2\Delta_{2\frac{1}{2}}$. This is apparently the first record of the observation of such a transition. The rotational term differences have been obtained and values of the rotational constants calculated. The initial states show marked departures from the usual form of rotational energy term, and exhibit a large doubling increasing with J. For $^2\Delta$ levels the Λ-doubling is expected to be negligible. The three bands are all found to have the same lower levels. The λ 5713 band shows a remarkable perturbation of its initial levels at $J' = 8\frac{1}{2}$. Estimates of the intensities of the lines have been made and compared with those expected for a transition between two case *a* $2\Delta_{2\frac{1}{2}}$ states. Although the agreement is generally good there are certain definite departures. The relation of the electronic levels of the molecule NiH to those of the atom Ni is considered. A catalogue of wave-lengths is given. AUTHORS.

1155. Band Spectrum of Aluminium Bromide (AlBr). H. G. Howell. *Roy. Soc., Proc.* 148*A*. *pp.* 696–707, *Feb.* 15, 1935.—A band system stretching from λ 2750 to λ 3000 has been produced by a h.f. discharge in AlBr. The great similarity of the spectrum to that of AlCl and the vibrational analysis show that it is due to the diatomic molecule AlBr. The bands are degraded to the red and have Q and R heads; the latter are double owing to the presence of both $AlBr_{79}$ and $AlBr_{81}$ molecules, the isotope separation being in agreement with theoretical expectations. No bands involving the level $v' = 4$ are observed, presumably owing to predissociation in the upper state. The vibrational analysis shows that the system origin ν_e = 35,883·5 cm.$^{-1}$ and that the vibrational constants have the following values in cm.$^{-1}$:

	ω_e	$\chi_e\omega_e$	$y_e\omega_e$
Upper state – – –	299·31	8·560	0·122
Lower state – – –	379·21	1·560	—

The intensity distribution does not exhibit a typical Condon parabola, but rather a straight line through the strongest bands. This may be due to the parabola being very narrow, or because all the bands which might otherwise have completed it are not present owing to predissociation. AUTHOR.

1156. Band Systems of Cadmium Fluoride. R. K. Asundi, R. Samuel and M. Zaki-Uddin. *Phys. Soc., Proc.* 47. *pp.* 235–246, *March*, 1935.—Two emission band systems attributed to CdF are described and analysed. One, in the orange region, is probably due to a $^2\Pi \rightarrow {}^2\Sigma$ transition, and the other, in the yellow-green, to $^2\Sigma \rightarrow {}^2\Sigma$. The vibrational analyses suggest that the two systems have a common lower state, $^2\Sigma$, which is presumably the ground state. The origins of the two systems are roughly 16,558 and 18,871 cm.$^{-1}$ respectively, and the vibrational coefficients ω_e and $x_e\omega_e$ are of the orders 694·3 and 4·96 for the lower $^2\Sigma$ state, 704·4 and 5·74 for the $^2\Pi$ state, and 672·4 and 5·14 for the excited $^2\Sigma$ state. The heats and products of dissociation and the electronic structures of the three states of CdF are discussed. AUTHORS.

1157. Rotational Analysis of the Ultra-Violet Bands of Phosphorus Monoxide. A. K. Sen Gupta. *Phys. Soc., Proc.* 47. *pp.* 247–257, *March*, 1935.—The structure of (0, 0), (0, 1) and (1, 0) bands of the ultra-violet system of the PO molecule has been analysed. The bands are due to a $^2\Sigma \rightarrow {}^2\Pi$ transition. Each band consists of six main branches P_2, Q_2, R_2, and P_1, Q_1, R_1 and two satellite branches $^OP_{12}$ and $^SR_{21}$. The potential-energy curves for both the upper and lower states of the system have been drawn on the basis of the equations given by Morse as well as by Rydberg. From these curves the Condon parabola for the intensity of the bands in the system has been obtained. The relevant molecular constants have been obtained. The products of dissociation in the different states are discussed. AUTHOR.

1158. Fundamental Vibrations of Molecules of the Type X_6 and X_6Y_6. (Miss) M. van den Bossche and C. Manneback. *Ann. Soc. Sci. de Bruxelles*, 54. *pp.* 230–279, *Dec.* 17, 1934.—Gives a dynamical analysis of the infinitesimal oscillations of a system of six mass points which in the equilibrium position lie in a plane and exhibit ternary symmetry. Formulæ for the fundamental vibration frequencies are deduced. Application of the results to the benzene molecule is in view. W. S. S.

1159. Relation Between Molecular Spectra and Constituent Electrons. H Deslandres. *Comptes Rendus*, 199. *pp.* 1543–1546, *Dec.* 26, 1934.—Gives verifications and new applications of the empirical formula $\nu = qd_1/r's'$ where ν is the wave-number of an infra-red frequency in cm^{-1}. of a molecule ; d_1 is a constant 1062·5 ; s' is the number of electrons in the outer ring or rings of constituent atoms of the molecule ; q is a whole number and r' is a whole number usually small. Examples are given to show that the formula has more than purely empirical significance. **Errata.** *ibid.* 200. *p.* 426, *Jan.* 28, 1935. A. C. M.

1160. Frequency of Rotation-Vibration Bands and Chemical Reactivity of Molecules in the Gaseous State. W. Heller. *Comptes Rendus*, 199. *pp.* 1611–1613, *Dec.* 26, 1934.—A tabular comparison is made between (*a*) the displacement of the frequency of the OH band caused by the replacement of the group R by R′ in the molecule ROH and (*b*) the change of chemical reactivity caused by the same replacement in the molecule RCl. The measure of chemical reactivity chosen is the fraction of fruitful collisions in the gaseous reaction of the chlorine compound with sodium. It is noted that a diminution of frequency of the OH is always associated with an increase of reactivity of the corresponding chlorine compound. No explanation is given. L. A. W.

1161. Vibrations of Symmetrical Tetratomic Molecules. Jenny E. Rosenthal. *Phys. Rev.* 47. *pp.* 235–237, *Feb.* 1, 1935.—The general method for obtaining the vibration frequencies of any symmetrical molecule is outlined, and the results of its application to the tetratomic case are given. The frequencies are derived for the most general force field consistent with geometrical symmetry, and also for a more specific case based on a simplified model. It is shown that the assumption of the rigidity of the bonds requires two different forces perpendicular to the lines of bond. The coplanar tetratomic and the collinear triatomic molecules are found to be the only ones of a number of molecules investigated so far, where an unambiguous determination of the physical force constants is possible. In the general case, no very definite meaning can, apparently, be attached to terms like " magnitude of bond constant." AUTHOR.

1162. Periodicity of Morse's Function. C. H. D. Clark. *Phys. Rev.* 47. *pp.* 238–240, *Feb.* 1, 1935.—The applicability of a simple modification of Morse's rule has been tested, and found generally satisfactory for simple non-hydride di-atoms and for hydrides of the *K*H period. Morse's function is shown to possess a periodic character, and to be capable of adjustment by the introduction of group numbers and period constants on the basis of the classification of di-atoms suggested by the present author. The contention that di-atoms should be regarded from the standpoint of their periodic group functions thus appears especially significant. AUTHOR.

1163. Potential Functions of Polyatomic Molecules. G. B. B. M. Sutherland and D. M. Dennison. *Roy. Soc., Proc.* 148*A*. *pp.* 250–271, *Feb.* 1, 1935.—A new representation of the force field existing in a polyatomic molecule is investigated, in which the potential energy of the molecule is expressed as the sum of very general potential functions of groups of atoms in the molecule, plus simple interaction energies between the groups. This is applied to the establishment of relations between the " parallel " vibration frequencies of the molecules C_2H_4, CH_2O, C_2H_6, CH_3F, CH_3Cl, CH_3Br, CH_3I and CH_4. The way in which the relations are fulfilled by the experimentally determined frequencies, indicates that the potential energy hypotheses are excellent approximations. The potential constants characterising the CH_2 and CH_3 groups vary as a rule only by a few per cent from molecule to molecule in conformity with the observed fact that molecules containing these groups exhibit characteristic infra-red and Raman frequencies. These potential constants are also briefly discussed from the standpoint of more complex molecules and from their significance in indicating particular types of chemical binding.

H. H. Ho.

1164. Interpretation of Continuous Spectra of Flames and Arc Discharges. W. Finkelnburg. *Zeits. f. Physik*, 93. 3–4. *pp.* 201–205, *Jan.* 4, 1935.—The properties and the interpretation of the continuous spectra emitted by flames and arc discharges are discussed. Besides the continua emitted by glowing solid particles and those explicable as reaction continua a continuous background always appears which depends on the pressure and degree of ionisation of the gas. The properties of this latter continuous spectrum indicate that it must be interpreted as an electron radiation. J. E. K.

1165. Zeeman Effect in Mercury and Perturbations. P. Jacquinot. *Comptes Rendus,* 199. *pp.* 1603–1604, *Dec.* 26, 1934.—The Zeeman effect in several Hg lines is studied in order to examine the perturbations caused by the proximity of the two levels 6*s* 4*d*, $^3D_1$ and $^1D_2$. The same anomalies as were found by Green and Loring [see Abstract 5068 (1934)] are observed. In addition, the 3654 line $(^3P_2 - {}^3D_2)$ shows a strong dissymmetry at 34,000 gauss. Helium has been studied in a similar way, but no anomaly is observed. C. B. A.

1166. Zeeman Effect of Bromine and Iodine. P. Lacroute. *Ann. de Physique,* 3. *pp.* 5–96, *Jan.,* 1935.—In order to classify the spectra, they were examined in the Schumann region using a grating of 1 m. radius. Lists are given of 180 Br lines and of 400 lines due to I. The Zeeman effect was studied with a large Rowland grating used in conjunction with a cylinder lens. The spectra were excited in quartz tubes by waves of about 10 m. length. Lists are given of 26 lines of BrI, 182 lines of BrII and 244 lines of I II. The classification of the BrI spectrum has been modified, the values of *g* for about 20 terms being given. In the BrII spectrum 26 lines have been classified and *g* is given for 14 terms. For I II 209 lines are now known and 54 terms, while values of *g* are given for 39 of these terms. The ionisation potential is given as 19·4 volts. F. S.

1167. Zeeman Effect of the Spectra of Arsenic. J. B. Green and W. M. Barrows, Jr. *Phys. Rev.* 47. *pp.* 131–135, *Jan.* 15, 1935.—Zeeman patterns of the spectra of As I, As II and As III have been measured. The results give *g*-values that are in general agreement with perturbation theory, although it appears that Goudsmit's method of adding an *s*-electron to parts of a configuration is not sufficiently accurate. AUTHORS.

1168. Raman Effect in Binary Mixtures of Sulphuric and Nitric Acids. L. Médard. *Comptes Rendus,* 199. *pp.* 1615–1617, *Dec.* 26, 1934.—Mixtures were made containing less than 0·4 % of water. A strong sharp line was found at 1400 cm^{-1}. belonging neither to H_2SO_4 nor HNO_3. The position of the line appeared to be independent of the composition of the mixture and appears even where there is less than 5/100,000 part of H_2SO_4 in the mixture. The intensity of this line even when the concentration is so small is very surprising. All the other lines belong either to H_2SO_4 or to HNO_3. As the concentration of the nitric acid diminishes, all the lines belonging to it increase in frequency, just as when nitric acid is diluted with water. The two lines 390 and 430 cm^{-1}. of H_2SO_4 are clearly separated in the mixtures, unless the HNO_3 exceeds 40 %, when the two lines merge into one another at about 420 cm^{-1}. None of the mixtures show the SO_4'' ion line at 990 cm^{-1}. None of the mixtures showed the fluorescence so easily obtained with impure H_2SO_4, even when impure acid was used. This shows that the impurities are easily oxidised. A. C. M.

***1169. Raman Effect and Temperature. Part 1. Ammonium Chloride, Bromide, Iodide. A. C. Menzies and H. R. Mills.** *Roy. Soc., Proc.* 148A. *pp.* 407–422, *Feb.* 1, 1935.—A description is given of a simple form of apparatus for obtaining Raman spectra of small quantities of crystal powders or frozen liquids over a large temperature range. It has been used to investigate the change with temperature of the Raman spectra of the chloride, bromide, and iodide of ammonium. The most striking feature is the appearance of a lattice frequency line in the chloride when the temperature is lowered below about −30° C. It is concluded that the ammonium tetrahedra are similarly situated in the cold chloride lattice and arranged anti-symmetrically in the bromide lattice below their respective transition temperatures, an arrangement also arrived at by Hettich on the grounds of piezoelectric behaviour. At the transition temperatures an instability sets in, such as the commencement of a rotation, which removes the asymmetry occasioned by the orientation of the tetrahedra, and so leads to a pseudo-symmetry. The assumption that the hydrogen atoms of neighbouring tetrahedra repel one another with a force which lessens as the distance between them increases, leads to the conclusion that the chloride should expand catastrophically and the bromide similarly contract as the rotation sets in, thus resolving this hitherto unexplained paradox.

AUTHORS.

1170. Quantitative Spectrum Analysis of Gas Mixtures. J. Heyes. *Zeits. f. phys. Chem.* 172. *Abt. A.* 2. *pp.* 95–104, 1935.—The condensed spark method of spectrum analysis is applied to the quantitative determination of mixtures of H_2, N_2, O_2 and He. Lower limits of sensitivity are found as follows: H_2 in air, 0·75 %; H_2 in N_2, 2 %; N_2 in H_2, ⅓ %; N_2 in O_2, ½ %. When high capacities are used in the secondary circuit, the intensity ratios of the lines are unaffected by changes of capacity and induction. The ultimate lines of the gases are found, and tables of lines of equal intensity are recorded.

C. B. A.

1171. Quantitative Spectrum Analysis of Sn-Pb Alloys. H. Schubert and K. Cruse. *Zeits. f. phys. Chem.* 172. *Abt. A.* 2. *pp.* 143–155, 1935.—The use of the rotating logarithmic sector in quantitative spectrum analysis is discussed and a process for determining the properties of the plates used is described. Investigations on 40 standard alloys containing from 0 to 100 % Pb in Sn show that there is no relationship between intensity of emitted light and the number of atoms present. Sources of error in method and theory of spectrum analysis are investigated. A method of preparing lead-free tin is described.

C. B. A.

See also Abstracts 949, 1095, 1131, 1134, 1230, 1233.

VELOCITY OF LIGHT.

See Abstract 1031.

VISION.

1172. Indirect Method for Measuring Stray Light within the Human Eye. S. H. Bartley and G. A. Fry. *J.O.S.A.* 24. *pp.* 342–347, *Dec.*, 1934.—A light source of variable brightness located at an angle $\theta°$ to the side of the direction of view increases the brightness difference threshold by an amount depending on the angle θ and the angular size and brightness of the light source. Using a test object consisting of a centre disc surrounded by an annulus, whose difference of brightness could be adjusted to the just perceptible value, the difference threshold was measured for various brightnesses of the light source. By removing the light source and superposing over the test object an additional "substitute stray light" brightness, the same effect on the threshold could be obtained.

This is interpreted as showing that with the light source in the field, there is an actual illumination of the foveal retina by light scattering in the eye, of amount corresponding to the "substitute stray light" brightness. Other experiments employing a different form of test object suggest, however, that direct nervous interaction in the retina may play a part in the increase of the brightness difference threshold by the extrafoveal light source. W. S. S.

1173. Colour-Vision Characteristics of Two Trichromats. W. D. Wright and F. H. G. Pitt. *Phys. Soc., Proc.* 47. *pp.* 205–217, *March*, 1935.—The authors' luminosity curves, trichromatic coefficients, mixture curves, complementary wave-lengths and their mixture in terms of luminosity, their hue-discrimination curves and some data on saturation discrimination have been obtained and the results tabulated. The importance, for visual research, of complete data for individual observers, rather than mean curves for different groups of observers, is emphasised. AUTHORS.

X-RAYS.

1174. Scattering Power of Pd for X-Rays. E. Nähring. *Zeits. f. Physik*, 93. 3–4, *pp.* 197–200, *Jan.* 4, 1935.—The atomic scattering power of Pd for Cu-K_α radiation is determined from powder photographs. Palladium black is used, alone, and also mixed with Al powder. The X-ray photographs are photometered, a Zeiss photometer being used. The scattering power is observed for eight reflecting planes and an F curve is plotted. This is found to agree with the theoretical curve obtained by assuming the Thomas-Fermi electron distribution, when allowance is made for the fact that the K absorption edge of Pd corresponds to a wave-length very much below that of Cu-K_α. J. T.

1175. Absolute Measurement of the Expenditure of Energy in the Ionisation of Argon by X-Rays. O. Gaertner. *Ann. d. Physik*, 21. 6. *pp.* 564–572, *Jan.*, 1935.—With improved arrangements earlier experiments on the energy consumption in the ionisation of argon have been repeated. The value obtained is 28·4 ± 0·5 instead of 28·8 ± 1 V per pair of ions. On the basis of the relative ionisation of air and argon, measured by Crowther and by the author, from this value there is deduced for air $\epsilon = 35{\cdot}2$ V (Gaertner) or $\epsilon = 37{\cdot}5$ V (Crowther). The deviation from the value given by Eisl, which is at present generally accepted, $\epsilon = 32{\cdot}2 \pm 0{\cdot}5$ V, lies accordingly outside the limit of errors of measurement. J. J. S.

1176. Auger Effect. E. H. S. Burhop. *Roy. Soc., Proc.* 148*A*. *pp.* 272–284, *Feb.* 1, 1935.—The Auger effect has been investigated theoretically and it has been found that all the definitely established experimental features are accounted for very satisfactorily by the quantum mechanical theory. In particular, the theory predicts the correct form for the variation of the effect with atomic number and for the relative magnitude of the effect in the different shells and sub-shells of an atom. The absolute magnitude of the predicted effect is rather higher than that observed experimentally, but this doubtless arises from the inexact (screened hydrogen-like) nature of the wave-functions employed. An appendix deals with the methods of computation of the hypergeometric functions involved. H. H. Ho.

1177. X-Ray Reflecting Power of Crystals. A. Faessler and G. Küpferle. *Zeits. f. Physik*, 93. 3–4. *pp.* 237–244, *Jan.* 4, 1935.—The reflecting powers of zinc blende, rock-salt, calcite, fluorite, bismuth, quartz, gypsum, beryl, mica and sugar are determined for three X-ray wavelengths, namely Ag–K_α, Fe–K_α and Ag–L_α. J. T.

1178. Structure of the Discontinuous Absorption of Gases Between 10 and 100 Å. J. A. Prins. *Physica*, 1. *pp.* 1174–1180, *Dec.*, 1934. *In French.*—The $L_{II,\ III}$-edges of A and CCl_4 and the K-edge of N_2 show fine-structure, which does not extend over more than 15 V. This is attributed to transitions of the inner electron to unoccupied bound ("optical") orbits. In A and N_2, the structure can be predicted in good agreement with experiment. The "natural" discontinuities in Ag, O, and C, produced on all plates by absorption in the light-sensitive film and in the anti-kathode, are discussed further. C. B. A.

1179. Simplification of Prins' Formula for Diffraction of X-Rays by a Perfect Crystal. F. Miller, Jr. *Phys. Rev.* 47. *pp.* 209–212, *Feb.* 1, 1935.—The intensity formula of Prins [see Abstract 167 (1931)] for diffraction of X-rays by a perfect crystal has been simplified so that $F(l)$ is a real, single-valued, algebraic function of l, the deviation of the glancing angle from the corrected Bragg angle. By neglecting absorption in the crystal, Darwin's formula is obtained in a new form. By differentiation the maximum ordinate of the diffraction pattern is obtained. To calculate per cent reflection (*i.e.*, maximum ordinate of the rocking curve of a double crystal spectrometer in the 1, − 1 position) $\int_{-\infty}^{+\infty} F(l)dl$ and $\int_{-\infty}^{+\infty} F^2(l)dl$ are needed, and these integrals have been evaluated analytically for Darwin's case of no absorption, leading to a value of $4/5$ for $P(0)$. To include absorption $F(l)$ has been expanded into a series in powers of B/D and an approximate formula obtained for $P(0)$ in terms of the constants of the crystal. This formula agrees with the graphically determined values of $P(0)$ to within a few per cent. AUTHOR.

1180. Molecular Arrangement and X-Ray Diffraction in Ionic Solutions. J. A. Prins. *J. Chem. Phys.* 3. *pp.* 72–80, *Feb.*, 1935.—The diffraction patterns of saturated $Th(NO_3)_4$ and $UO_2(NO_3)_2$ solutions, examined with Cu $K\alpha$ radiation, consist mainly of a pronounced ring, shifting to smaller angles and becoming fainter on dilution. The more or less regular arrangement of the ions thus indicated is termed "superarrangement" to distinguish it from that with smaller periodicity of the water molecules. The superarrangement expands and gets more diffuse as dilution is increased. With solutions of $AgNO_3$, $Pb(NO_3)_2$, $Ba(NO_3)_2$ and $Pb(C_2H_3O_2)_2$, the intensity shows no pronounced maxima and minima and does not decrease markedly when the diffraction angle approaches zero; here the existence of a large fraction of undissociated molecules, with a gaseous distribution, is assumed. Solutions of LiI, RbBr, LiBr and other alkali halides give a broad ring, the position of which is independent of concentration. This ring is ascribed mainly to interference between the scattering from a heavy ion and that from the water molecules around it. A general theory of diffraction by solutions is formulated and applied to some of the experimental cases. T. H. P.

1181. Efficiency of Fluorescent X-Ray Screen. O. Gaertner. *Zeits. f. techn. Phys.* [illegible] *pp.* 9–10, *Jan.*, 1935.—The efficiency of a cadmium tungstate screen is measured by a difference method, a thermopile being used to measure the energy of the visible radiation and of the X-rays [see Abstract 1625 (1934)]. The ratio of the emitted energy (visible radiation) to the incident energy (X-rays) per square cm. is 0·0027, and since 50 % of the X-rays are absorbed by the screen, the efficiency is 0·54 %. J. T.

***1182. Tube Counter Measurement and the X-Ray Unit. H. Wilhelm.** *Zeits. f. techn. Physik*, 16. 1. *pp.* 2–8, 1935.—A Geiger-Müller counter with walls of graphitic bakelite is shown to be equivalent to an air-walled ionisation chamber for X-rays with wave-lengths lying between 0·71 and 1·54 Å. A general relation between tube counter design and the number of X-ray units registered, as a function of the wave-length of the rays cannot be given. However, the ratio of collision number to doses is practically constant for the given counter between 0·5 and 1·5 Å. With a carefully standardised counter, the intensity of a homogeneous beam of X-rays can be measured up to a rate of 10^{-7} r./sec. F. C. C.

***1183. Simplified Apparatus for X-Ray Quantitative Chemical Analysis with the Kathode-Ray Tube. W. P. Jesse.** *Rev. Sci. Instruments*, 6. *pp.* 47–50, *Feb.*, 1935.—A compact oil-immersed apparatus is here described in which kathode rays from a kathode-ray tube strike the substance to be analysed and excite characteristic X-rays. The measurement of these allows a quantitative chemical analysis of the substance to be made. The apparatus is a simplification of apparatus already in use [see Abstract 1526 (1933)]. Data are given showing the accuracy and sensitivity of the analysis method. AUTHOR.

***1184. Johann X-Ray Spectrometer for High Vacuum, Employing Concave Crystal. A. Sandström.** *Zeits. f. Physik*, 92. 9–10. *pp.* 622–630, *Dec.* 7, 1934.—Details are given of a larger spectrograph of the type already described [see Abstract 4568 (1933)]. The intensity distribution in the broadening of the lines due to focusing defect and oblique incidence on the photographic plate is found to show approximately Gaussian form. W. S. S.

See also Abstracts 1001, 1093, 1242, 1273.

HEAT.

CALORIMETRY.

1185. Theory of Specific Heat of Crystals. Parts I and II. M. Blackman. *Roy. Soc., Proc.* 148*A. pp.* 365–406, *Feb.* 1, 1935.—In Debye's theory the crystal is replaced by a continuum as far as the distribution of frequencies is concerned, while the Born- v. Kármán theory is based on lattice theory in which the fact that the crystal is composed of discrete particles is taken into account. In the present work the Born- v. Kármán theory is used to determine the form of the spectrum of frequencies and the way in which the specific heat of real crystals should differ from that predicted by Debye's theory is discussed. The results are compared with experiment and a theoretical justification for the Nernst-Lindemann formula for specific heats is given. L. G. C.

1186. Heat of Condensation by Direct Method. Part II. Intensively Dried Liquids. A. Smits and D. Cannegieter. *Zeits. f. phys. Chem.* 172. *Abt. A.*1. *pp.* 1–32, 1935.—Measurements had previously been made of the heat of condensation of benzene, bromine and ethyl bromide for the case in which the liquids were in the normally dried state [see Abstract 2939 (1934)]. Results are now given for intensively dried samples of these liquids. This treatment lowers the heat of condensation of benzene by an amount which depends on the extent of the drying and the rate of the transformation. For ethyl bromide either an increase or decrease may result according to the conditions of the experiment, but only small deviations are obtained for bromine. These results are explained on the assumption that the molecules actually consist of two pseudo components. R. W. P.

1187. Recent Progress in Calorimetry and Thermochemistry. W. A. Roth. *Zeits. f. Elektrochem.* 41. *pp.* 112–122, *Feb.*, 1935.—A general survey of theoretical and experimental work during the last three years. L. G. C.

See also Abstracts 1190, 1195, 1196.

CONDUCTION.

See Abstracts 946, 972, 1297.

CONVECTION.

1188. New Form of the Prandtl Equation for Heat Transfer. J. Kuprianoff. *Zeits. f. techn. Physik*, 16. 1. *pp.* 13–15, *Jan.*, 1935.—An examination of existing experimental results for heat transfer by turbulent fluid flow in tubes shows that the quantity A in the Prandtl equation for the heat transfer, $\alpha d/\lambda = 0{\cdot}03956\,(\mathrm{Re})^{3/4}(\mathrm{Pr})/[1 + A\,(\mathrm{Re})^{-1/8}(\mathrm{Pr} - 1)]$, is not a constant but is a function of Re and Pr. The form of this function is determined, and when inserted in the Prandtl equation gives $\alpha d/\lambda = 0{\cdot}03956\,(\mathrm{Re})^{3/4}(\mathrm{Pr})/[1 + 0{\cdot}44\,(\mathrm{Pr})^{-1/8}(\mathrm{Pr} - 1)]$. It is pointed out that the equation previously suggested by ten Bosch for the heat transfer from water is a special case of this new equation. R. W. P.

1189. Heat Transfer from Cylinder in Transverse Stream of Fluid. J. Small. *Phil. Mag.* 19. *pp.* 251–260, *Feb.*, 1935.—The total heat transfer, due to forced convection, from the surface of a cylinder 4½″

in diameter placed vertically across a 2 ft. square section wind-channel is determined from observations of the electrical input to a stirred internal fluid. Observations made at surface temperature excesses of 60 to 70° C. and for wind velocities ranging from 5 to 40 ft. per sec. fit the equation $Hd/K\theta = 2\cdot 96\ (Vcd/K)^{0.626}$. These values are in agreement with the results of Griffiths and Awbery but are rather higher than the mean curve of correlated values given by Fishenden and Saunders. A surface thermopile is used to measure the heat transfer in a vertical plane in the surface of the cylinder, and by rotating the cylinder the local variation in heat transfer is obtained. This distribution has a minimum value at the sides of the cylinder, and is of the same general form as that found by Lohrisch, Drew and Ryan, and Klein. R. W. P.

DILATATION.

See Abstract 989.

MELTING AND BOILING POINTS.

1190. Freezing Points of Mixtures of H_2O and D_2O. Latent Heat of Fusion of D_2O. V. K. La Mer and W. N. Baker. *Am. Chem. Soc., J.* 56. *pp.* 2641–2643, *Dec.*, 1934.—The freezing points of H_2O and D_2O mixtures are determined, and extrapolation indicates 3·802° C. as the freezing point of pure D_2O. Using the thermodynamic equation suggested by Seltz [see Abstract 2111 (1934)] the latent heat of fusion of pure D_2O is calculated to be 1600 cal./mol. The values of the latent heat of fusion of 99·48 % D_2O obtained experimentally is only 1510 cal./mol. It is considered that the discrepancy may be due to the fact that Seltz neglects the effect of the equilibrium, $H_2O + D_2O = 2\ HDO$, in his treatment. R. W. P.

1191. Indene as a Cryoscopic Solvent. W. Klatt. *Zeits. f. phys. Chem.* 171. *Abt.A.* 5–6. *pp.* 454–462, 1934.—Indene has been found very suitable for cryoscopic investigations, inasmuch as the melting point of the colourless product is − 1·76° C., the cryoscopic constant has been most carefully evaluated as 7·28°, and the latent heat of fusion has been determined calorimetrically as 19·9 cal./gm. It has been discovered that alcohols and monobasic organic acids exhibit a characteristic anomalous cryoscopic behaviour in indene, while naphthalene causes a rise in freezing point due to mixed crystal formation. H. H. Ho.

1192. Rate of Setting of Glass During Working. I. I. Kitaigorodsky and N. W. Solomin. *Soc. Glass Technol., J.* 18. *pp.* 323–335, *Dec.*, 1934.—A study has been made of the comparative rates of setting of two colourless glasses and of one of these glasses with four others of similar composition, except that they were coloured respectively with 2 % of cobalt, ferrous, ferric and manganese oxides. The effects of temperature coefficient of viscosity, heat capacity, thermal conductivity and infra-red radiation were considered. Because of their greater radiating powers, the surfaces of glasses containing cobalt, ferrous and ferric oxides set quicker than that of the corresponding clear glass; but the glass containing MnO differed little from the colourless glass. AUTHORS.

1193. Amounts of Xenon and Krypton in Atmospheric Air. G. Damköhler. *Zeits. f. Elektrochem.* 41. *pp.* 74–80, *Feb.*, 1935.—The amounts of Xe and Kr in atmospheric air are redetermined by a method in which the noble gases from a large volume of starting material are concentrated by adsorption on charcoal. Two sets of experiments are made, one upon atmospheric air and the other upon oxygen from a liquid air machine with a controlled performance. The results, which are in good agreement with those of C. Moureu and A. Lepape (1926), give $1\cdot08 \pm 0\cdot1$ parts of Kr and $0\cdot08 \pm 0\cdot03$ parts of Xe to 10^6 parts of air by volume. L. A. W.

See also Abstracts 1186, 1193, 1197.

TEMPERATURE, MEASUREMENT OF.

See Abstracts 977, 1119, 1130.

THERMOCHEMISTRY.

1194. Relative Partial Molar Heat Content and Partial Molar Heat Capacities of Sodium Chloride Solutions. E. A. Gulbransen. *Univ. Pittsburgh, Bull.* 31. *pp.* 143–149, *Oct.* 1, 1934.—The heats of dilution of aqueous sodium chloride solutions were measured by means of a differential adiabatic calorimeter. The results are in accord with the Debye-Hückel theory of strong electrolytes. L. G. C.

1195. Thermal Data for Aqueous Sodium Chloride Solutions. E. A. Gulbransen and A. L. Robinson. *Am. Chem. Soc., J.* 56. *pp.* 2637–2641, *Dec.*, 1934.—Heats of dilution of aqueous NaCl solutions have been measured at low concentrations at intervals of 5° from 25° to 10° and have been extrapolated to infinite dilution to obtain integral heats of dilution. The values of relative partial molal heat contents and partial molal heat capacities have been calculated for the concentration and temperature ranges of the measurements. AUTHORS.

***1196. Heats of Admixture, Heats of Evaporation and Association. K. L. Wolf, H. Pahlke and K. Wehage.** *Zeits. f. phys. Chem.* 28. *Abt.B.* 1. *pp.* 1–13, 1935.—Suitable apparatus is first described for measuring the heats of admixture of liquids, following which are given the experimental results for mixtures of aliphatic alcohols with hexane and with benzene (over the whole range of concentrations) and also for benzene and cyclohexane with hexane. Data are also included for the heats of evaporation of alcohols and ketones. The heats of admixture and evaporation are discussed with respect to the association of alcohols and in conjunction with polarisation measurements. The related problems of the steric influence of structure and of free rotatability are also investigated. H. H. Ho.

*** 1197. Methods for Investigating Thermal Changes Occurring during Transformations in a Solid Solution. C. Sykes.** *Roy. Soc., Proc.* 148*A*. *pp.* 422–446, *Feb.* 1, 1935.—A consideration of the standard cooling curve methods shows that such methods are likely to give unreliable results when applied to transformations consisting of atomic rearrangement in a homogeneous solid solution. A modified cooling curve method is described which is more reliable than the usual methods. In order to determine quantitatively the heat involved in such transformations a specific heat-temperature curve is required, and a new experimental method for obtaining curves is described. These two methods have been used to investigate the transformations occurring in β-brass and iron-aluminium alloys, with interesting results. AUTHOR.

1198. Energies of Hydrocarbon Molecules. R. Serber. *J. Chem. Phys.* 3. *pp.* 81–86, *Feb.*, 1935.—The energies of a number of hydrocarbon molecules have been calculated by the Heitler-London-Pauling-Slater method with two objects in view, first, to see if this simple theory leads to the correct energies of formation, and second, to determine what significance can be attached to the empirical additivity rule for bond energies. The equations involve three parameters, which roughly speaking, determine the gross energies of a C — H bond, a C — C bond, and a C = C bond. These have been evaluated from the observed energies of methane, ethane and ethylene. The energies calculated for other hydrocarbons then agree surprisingly well with the observed values. Nevertheless, the validity of an empirical bond additivity rule seems to be purely fortuitous. The calculations further indicate that the theoretical significance ordinarily ascribed to the so-called "observed resonance energies" is a very questionable one. AUTHOR.

1199. Theory of the Process of Combustion. Part III. N. Semenoff. *Zeits. f. phys. Chem.* 28. *Abt.B.* 1. *pp.* 43–53, 1935.—According to the chain theory, the upper and lower inflammability limits in oxidation gas reactions should be independent of the number of centres initiating the chain. Experiment shows, however, that artificial increase of this number either photochemically or by ionisation or by admixture of hydrogen or oxygen atoms causes displacement of the inflammability limits in both directions. Different centres are differently active in this respect, oxygen atoms being the most effective. Unpublished results obtained by Nalbandjan show that, with a sufficiently high concentration of oxygen atoms and at a pressure above a certain limiting value, the mixture $2H_2 + O_2$ burns for 0·1 sec. with the wall temperature 15–20° and with the temperature of the combustion zone not over 150° C. All these facts, which contradict the older theory, may be simply explained by additional assumptions on the increased branching of the chains in their reciprocal reactions. This hypothesis affords a new explanation for the spark ignition of explosive mixtures and appears to throw light also on the phenomena of flame propagation. [See Abstract **2493** (**1931**).] T. H. P.

1200. Theory of Degenerate Explosions. N. Semenoff. *Zeits. f. phys. Chem.* 28. *Abt.B.* 1. *pp.* 54–64, 1935.—It is shown theoretically that the symmetrical S-shaped curves typical for various chemical reactions may be derived from the theory of degenerate explosions [see Abstract **2493** (**1931**)] on the assumption that the probability of branching δ and the probability of chain-rupture are independent of the concentration of the initial substance. Curves of a different type are obtained if the reciprocal action of the chains is assumed. In this case the reaction proceeds more rapidly and at a lower temperature as the number of centres is increased artificially or by heat movement. The kinetic curve takes up a form varying with the probability of branching of the chains, and may approach the unimolecular law or the law of zero order. In the latter case the velocity of reaction, up to 50–60 per cent, does not depend on the amount of the substance which has reacted, but its value varies with the initial concentration. A number of experimental data supporting these conclusions are given. The hypothesis is advanced that many unimolecular reactions are non-stationary processes of the type of degenerate explosions. T. H. P.

1201. Kathodic Combustion of Hydrogen and Carbonic Oxide. G. I. Finch. *Chem. Soc., J. pp.* 32–39, *Jan.*, 1935.—Summary of observations on combustion initiated by electric discharge, and of the factors which influence the reactions taking place. A. S. C. L.

1202. Equation for Hydrogen-Oxygen Explosion Limits. H. H. Storch and C. W. Montgomery. *Am. Chem. Soc., J.* 56. *pp.* 2644–2646, *Dec.*, 1934.—An equation has been suggested for representing the explosion limits of H_2-O_2 mixtures as a function of the partial pressures of the reactants. This equation is shown to be qualitatively consistent with a series of possible reactions for the chain branching and chain breaking mechanisms; and it is in quantitative agreement with most of the available data. AUTHORS.

1203. Anomalous Pressures and Vibrations in Gas Explosions. Dissociation Energy of $2H_2O \rightleftarrows 2(OH) + H_2$. B. Lewis and G. v. Elbe. *J. Chem. Phys.* 3. *pp.* 63–71, *Feb.*, 1935.—Theoretical explosion pressures are calculated for H,O mixtures, with addition of various inert gases, from band spectra data. Energies of dissociation calculated for $H_2O \rightarrow H + OH$ and for $OH \rightarrow H + O$ are 114,000 and 104,160 (both ± 1000) cal. Explanations are suggested for some anomalies observed.

A. S. C. L.

1204. Inert Gas Effects at the Lower Explosion Limit of Phosphine-Oxygen Mixtures. S. C. Gray and H. W. Melville. *Faraday Soc., Trans.* 31. *pp.* 452–461, *Feb.*, 1935.—The effect of foreign gases on the lower explosion limit of $PH_3 - O_2$ mixtures has been determined as accurately as the experimental conditions will permit. H_2, Ne, A, N_2, CO_2, N_2O, and SO_2 all lower the limit in the normal way by impeding the diffusion of the chains to the walls. There is no measurable gas phase inhibition when the pressure of the gas is of the same order as that of the phosphine and oxygen. This agrees with observations on the effect of some of these gases on the upper limit. C_2H_4, C_6H_6, $PbMe_4$, and CCl_4 all raise the lower limit in marked contrast to the lowering of the limit observed with $P_4 - O_2$ mixtures. It is shown that the reason for the difference is that the probability of branching of chains in the $PH_3 - O_2$ reaction is less than that in $P_4 - O_2$ mixtures, and that a given inhibitor exerts a more powerful influence on the former reaction. The value of the inhibition coefficient has been calculated and in the case of ethylene, checked by measuring the inhibition of the stable photo-oxidation of phosphine. An extended table of inert gas coefficients has been compiled. [See Abstract 4986 (1934).]

AUTHORS.

1205. Quantum Mechanical Effects in Reactions Involving Hydrogen. R. P. Bell. *Roy. Soc., Proc.* 148*A*. *pp.* 241–250, *Feb.* 1, 1935.—In a previous paper [see Abstract 1957 (1933)] it was shown that classical mechanics are not adequate to treat the transition of a H atom or proton across an energy barrier of the dimensions commonly met with in chemical reactions. The treatment given was based on an exact solution of the Schrödinger equation and a type of potential curve having no discontinuities in slope, but owing to the laborious nature of the computations involved, no attempt was made to investigate quantitatively the effect of variations in the heat of activation, the width of the barrier, or the mass of the particle. The present paper describes an approximate treatment leading to simple equations which can be applied directly to investigate these points. Expressions are deduced for the permeability of a parabolic potential barrier to a stream of particles with Maxwellian energy distribution. Figures are given illustrating the application of these expressions to barriers of various dimensions. It is shown that if the barrier has dimensions of the order of magnitude met with in chemical reactions, then the system will deviate considerably from classical behaviour at easily attainable temperatures, provided that the particle is a H atom or proton. The effect of the mass of the particle is also investigated, with special reference to the behaviour of the two isotopes of H. It is shown that even in the absence of differences of zero point energy, the effect of the mass on the permeability may lead to large differences in the kinetic behaviour of hydrogen and deuterium. H. H. Ho.

1206. Activated Complex in Chemical Reactions. H. Eyring. *J. Chem. Phys.* 3. *pp.* 107–115, *Feb.*, 1935.—The calculation of absolute reaction rates is formulated in terms of quantities which are available from the potential surfaces which can be constructed at the present time. The probability of the activated state is calculated using ordinary statistical mechanics. This probability multiplied by the rate of decomposition gives the specific rate of reaction. The occurrence of quantised vibrations in the activated complex, in degrees of freedom which are unquantised in the original molecules, leads to relative reaction rates for isotopes quite different from the rates predicted using simple kinetic theory. The necessary conditions for the general statistical treatment to reduce to the usual kinetic treatment are given. AUTHOR.

See also Abstracts 965, 1129, 1187.

THERMODYNAMICS.

1207. Compressibility of and an Equation of State for Gaseous Ethane. J. A. Beattie, C. Hadlock and N. Poffenberger. *J. Chem. Phys.* 3. *pp.* 93–96, *Feb.*, 1935.—The compressibility of gaseous ethane (C_2H_6) has been determined from 0·5 to 5·0 mol./l. and from 25° to 250° C. with an estimated accuracy of 0·2 % or better. Above 250° C. ethane decomposes at an appreciable rate when confined in steel. An equation of state is fitted to the data. The average deviation of the calculated from the observed pressure is 0·13 atmosphere or 0·21 %. The equation of state extrapolates to the critical pressure (at 7 mol./l. and 32·1° C.) with an error of 10 % and calculates the weight of a normal litre to 0·2 %. The vapour pressures of liquid ethane at 0° and 25° C. are given. AUTHORS.

1208. Critical Constants of Propane. J. A. Beattie, N. Poffenberger and C. Hadlock. *J. Chem. Phys.* 3. *pp.* 96–97, *Feb.*, 1935. —The critical constants of propane (C_3H_8) are: $t_c = 96 \cdot 81 \pm 0 \cdot 01°$ C, $p_c = 42 \cdot 01 \pm 0 \cdot 02$ normal atmospheres, $v_c = 0 \cdot 195$ l./mol. (4·43 cc. per gm.), $d_c = 5 \cdot 13$ mol./l. (0·226 gm. per cc.). The uncertainty in the critical volume and density is 1 %. AUTHORS.

1209. Discontinuities in Energy and Specific Heat. A. Bijl. *Physica*, 1. *pp.* 1125–1142, *Dec.*, 1934. *In English.*—The paper deals with transitions from one phase to another considered as a process of association. The process is discussed from the point of view of statistical mechanics, and the condensation of a gas and the transition of $NaNO_3$ at 275° C. are considered by way of examples. L. G. C.

1210. Latent Heat of Vaporisation at a Characteristic Temperature. R. Lautié. *Comptes Rendus*, 200. *pp.* 58–59, *Jan.* 2, 1935.—Herz has shown that for normal or slightly associated liquids the characteristic density $D-D_c$ is related to the characteristic temperature $\theta = T_c - T$ by the empirical relation: $D-D_c = (D_0-D_c)\theta^v/T_c^v$, and the author has already shown [see Abstract 71 (1935)] that the difference of the liquid-vapour densities of a pure body, practically not dissociated, is $D-d = D_0\theta^{0 \cdot 3}/T_c^{0 \cdot 3}$, from which it is shown to follow that $(D-d)^4 = D_0^4(D-D_c)/(D_0-D_c)^3$. It is then deduced that $D_c - d = D_0\theta^{0\cdot3}/T_c^{0\cdot3} - (D_0 - D_c)\theta^{0\cdot4}/T_c^{0\cdot4}$, and that $(D + d)/2 = D_c + (D_0 - D_c)\theta^{0\cdot4}/T^{-0\cdot4} - D_0\theta^{0\cdot3}/2T_c^{0\cdot3}$, relations which are as satisfactory as the generalised law of the rectilinear diameter due to Cailletet and Mathias. From the Herz relation $L = L_0(D - D_c)/(D_0 - D_c)$, where L is the latent heat of evaporation, it follows, by combining it with the relation $\gamma = \gamma_0(D - D_c)^3/(D_0 - D_c)^3$, that $L = L_0 \cdot \gamma^{\frac{1}{3}}/\gamma_0^{\frac{1}{3}}$, from which is deduced that $L = L_0(D - d)^{4/3}/D_0^{4/3} = L_0 \cdot \theta^{0\cdot4}/T_c^{0\cdot4}$. The last formula is shown to give satisfactory results with the experimental data of Cailletet and Mathias for normal pentane. H. H. Ho.

1211. Phase Equilibrium of the Third Kind. E. Justi and M. v. Laue. *Zeits. f. techn. Physik*, 15. 12. *pp.* 521–528, 1934. *Phys. Zeits.* 35. *pp.* 945–952 ; *Disc.*, 952–953, *Dec.* 1, 1934.—Recent experimental observations, particularly those of Justi on the supercooling of O_2 at 43·5° K., have led the authors to suggest the existence of a third kind of equilibrium between two different phases. In the *Discussion* **W. H. Keesom** prefers to speak of the transformation, rather than the equilibrium as being of a higher order. **K. Clusius** suggested that the case of O_2 considered may not be a simple phase change. [See Abstract 797 (1935).] R. W. P.

1212. Effect of Pressure on Phase Equilibria of Sodium Tungstate and Related Thermodynamic Properties. R. W. Goranson and F. C. Kracek. *J. Chem. Phys.* 3. *pp.* 87–92, *Feb.*, 1935.—The substance is trimorphous at atmospheric pressure, as follows : Form I, 695·5° (melting point) to 588·8° ; Form II, 588·8° to 587·6° (just below), and Form III, below the latter. Density = 5·13 ± 0·01. Various other thermodynamic effects are discussed. F. I. G. R.

1213. Thermodynamic Study of Liquid Potassium Amalgams. Marion H. Armbruster and J. L. Crenshaw. *Am. Chem. Soc.*, *J.* 56. *pp.* 2525–2534, *Dec.*, 1934.—The e.m.f. of the concentration cell potassium (amalgam concentration c_1)—KCl (aqueous solution)—potassium (amalgam concentration c_2) is measured at 15, 25, and 35° C. over a range of liquid amalgam concentrations using dropping electrodes. It is concluded that amalgams of concentrations between 0·01 and 0·40 gm. of K per 100 gm. of Hg give e.m.f.s which are reproducible within a few hundredths of 1 mV, but that reliable results cannot be obtained with amalgam concentrations below this range. The effects of type of dropping electrode, rate of flow, etc., are investigated. The free energy of transfer of potassium from one amalgam to another is calculated from the results and found to agree with that derived from measurements of the activity of potassium in mercury. The standard electrode potential of potassium is measured and found to be 2·9243 volts at 25° C. Determinations are made upon the solubility of K in Hg from 0 to 35° C. L. A. W.

1214. Statistical Mechanics of Regular Solutions. E. A. Guggenheim. *Roy. Soc.*, *Proc.* 148*A*. *pp.* 304–312, *Feb.* 1, 1935.—The methods of statistical mechanics, as used in a previous paper [see Abstract 2617 (1932)] to deduce the laws of ideally dilute solutions and of perfect solutions, are extended to apply to solutions of a more general type. In accordance with a suggestion of Hildebrand these are called regular solutions. By treating the molecules of the two components of a binary solution as spheres of approximately the same size with short range fields of force it is possible to predict the general behaviour of the thermodynamic functions for such a solution. It was not found possible to deduce the exact form of these functions, but a form is suggested that is at least qualitatively correct. On the other hand it is shown that the semi-empirical formulæ proposed by Hildebrand and other authors are inconsistent with the principles of statistical mechanics. AUTHOR.

1215. Thermodynamic Functions of Tetramethylmethane. L. S. Kassel. *J. Chem. Phys.* 3. *pp.* 115–116, *Feb.*, 1935.—The Q-sum corresponding to la Coste's eigenvalues for the rotational levels of tetramethylmethane has been expressed by the usual asymptotic expansion. The relatively large coupling terms between the various rotations cancel almost exactly in the Q-sum, so that the thermodynamic functions are scarcely affected by the coupling. AUTHOR.

1216. Electric Charges of Disperse Systems, which are the Seats of Physico-Chemical Reactions. N. Rashevsky. *Physics*, 6. *pp.* 33–34, *Jan.*, 1935.—In a number of previous papers a mathematical study was made of small drops, which either absorb or produce some substances by virtue of physico-chemical reactions. This creates in the drop and in the surrounding medium gradients of concentrations of corresponding substances. In this note it is pointed out that when the reacting substances are ionised, these gradients will result in the appearance of electric charges and electric fields. An estimation shows that they are quite comparable with electric charges, produced by other factors in disperse systems. The fundamental property of the charges here considered is that they disappear as soon as the reactions cease. Their importance in biological systems is pointed out. [See following Abstract.] AUTHOR.

1217. Mechanism of Division of Small Liquid Systems which are the Seats of Physico-Chemical Reactions. Part II. N. Rashevsky. *Physics*, 6. *pp.* 35–37, *Jan.*, 1935.—In continuation of a previous paper, the same mathematical method is applied to a system, consisting of two spherical concentric drops, under the assumption that a reaction takes place only in the outer larger drop, but not in the inner one. It is found, however, that even in that case the inner drop may become unstable for infinitesimal deformations, and spontaneously elongate. [For Part I see Abstract 386 (1935).] AUTHOR.

***1218. Dissociation Pressures of Salt Hydrates. D. G. R. Bonnell and L. W. Burridge.** *Faraday Soc., Trans.* 31. *pp.* 473–478, *Feb.*, 1935.—The dissociation pressures of disodium hydrogen phosphate, heptahydrate, zinc sulphate, hexahydrate and the heptahydrates of the sulphates of zinc, magnesium, nickel and ferrous iron have been determined at 10°, 15°, 20° and 25° C. by the dynamic method. A new type of water vapour saturator, which removes the danger of spray formation, has been described. The heats of hydration for the various reactions have been calculated from the dissociation pressure data by means of the Clausius-Clapeyron equation. AUTHORS.

See also Abstracts 972, 973, 1013.

VAPOUR PRESSURE.

1219. Vapour Tension in a Crystal System. D. Balarew. *Zeits. f. phys. Chem.* 171. *Abt.A.* 5–6. *pp.* 466–468, 1934.—The connection between the colloidal structure and vapour tension of a system consisting of powdered crystals, is shown experimentally. J. T.

See also **Abstracts 1108, 1207, 1218.**

ACOUSTICS.

1220. Magnetostrictive Oscillation of Chladni Plates. R. C. Colwell and E. A. Bryant. *Frank. Inst., J.* 218. *pp.* 739–748, *Dec.*, 1934.—The Chladni plates were supported on a nickel rod which was set in vibration at audio frequency by coils forming part of a valve circuit. The frequency employed varied from 12 to 15 kc and the plates vibrated at the same frequency or, in the case of the heavier plates, at certain octaves of the rod below the actual frequency. Ritz's formula [see Abstract 772 (1909)] was used in verifying the observed frequencies. The approximate mathematical theory of the effect is touched upon and has been already discussed [see Abstracts 1973, 1974 (1933)]. The paper contains photographic reproductions of a number of complicated sand figures on square and circular plates and with reference to the latter Kirchhoff's equation is a complete mathematical solution for all cases. G. E. A.

1221. Speed of Sound in Quartz. A. de Gramont and D. Béretzki. *Comptes Rendus*, 199. *pp.* 1273–1274, *Dec.* 3, 1934.—The observed frequency of a quartz plate may deviate as much as 20 % from the calculated value. The authors find that the speed of sound in quartz varies from 4748 to 6094 m./s. A plate of quartz is taken perpendicular to a binary axis. From this is cut a series of bars of the same dimensions but with different orientations with respect to the optic axis. The angle specified is that between the greatest length of the bar and the optic axis, and is measured in the clockwise direction. The speed of sound, measured for each bar along the "electric axis," *i.e.*, perpendicular to the primitive plane of the plate, is found to vary continuously, being greatest when the angle is zero and least when the angle is 30°. The dimensions of the bars were 4·5 × 4·5 × 21·5 mm., and a table is given of the angles, speeds of sound, frequencies and apparent moduli of elasticity. G. E. A.

1222. Instantaneous Speeds in Air of Explosion Reports at Short Distances from the Source. F. L. Partlo and J. H. Service. *Physics*, 6. *pp.* 1–5, *Jan.*, 1935.—In the first series of measurements the source was one No. 6 blasting cap, while in the second series 1 lb. of 50 % nitroglycerin stick dynamite was used as source. A telephone carbon button microphone was the receiver and was held fixed in location while shots were fired successively at 5, 8, 12·5, 25, 35, 50, 100 and 600 m. distances. A two-element string oscillograph was used for timing, one element recording the instant of firing, the other element recording the arrival of the wave at the microphone. The work was done at time of no perceptible wind; air temperatures were measured carefully; no humidity measurements were made. Travel times could be read reliably to 10^{-4} sec. and distance measurements were at least correspondingly good. Instantaneous speeds were obtained by plotting time computed minus time observed against distance and measuring slopes of the resulting curve. Since this work was incidental to seismic prospecting, the observations were not quite as numerous as those of v. Angerer and Ladenburg [see Abstract 1670 (1922)]. However, the results are similar as regards abnormally high speeds near the source. Also, the use of instantaneous speeds appears to show abnormally low speeds a little farther from the source, perhaps masked in the work of v. Angerer and Ladenburg due to the use by them of average speeds instead of instantaneous speeds.

AUTHORS.

1223. Absorption of Ultrasonic Waves in Liquids by an Optical Method. E. Baumgardt. *Comptes Rendus,* 199. *pp.* 1383–1385, *Dec.* 10, 1934.—Light waves passing through a liquid in a direction parallel to the plane of ultrasonic waves converge to focal lines. The positions of the focal lines may be fixed by a stroboscopic method and observed by a microscope. If the powers necessary to focus the rays at distances z_1 and z_2 from the plane source of ultrasonics are ω_1 and ω_2, it is shown that the coefficient of absorption α_e is given by $\alpha_e = \{1/2(z_1 - z_2)\} \log_e(\omega_1/\omega_2)$. When a piezoelectric quartz is used, ω_1 and ω_2 can be obtained from the h.f. currents through the quartz. [See also Abstracts 1665 and 2122 (1934).] G. E. A.

1224. Refraction of Ultrasonic Waves. W. Bez-Bardili. *Phys. Zeits.* 36. *pp.* 20–24, *Jan.* 1, 1935.—Using the method of Bär and Meyer [see Abstract 3498 (1933)] light rays from an arc pass through a red filter to a perforated diaphragm in front of a vessel holding xylol excited by the ultrasonic waves. The mean speed of ultra sounds of different frequencies in xylol is 1336 m./s. In a table of measurements with prisms of Al, Cu, Fe, Ni and glass, the speeds of ultra-sounds and the refractive indices of the materials are given. In nickel the speed of ultra-sounds is about 50 % higher than that for audio-frequencies. The effect of cylindrical lenses is shown by diffraction figures. With two liquids the diffraction effect and the refraction effect lead to results which agree, *viz.*, speed of ultra sounds in glycerin 1900 m./s., in water 1500 m./s. In addition a brass cylinder is used to give a whispering gallery effect, and a wire grating is found to act both as a reflection and a transmission grating. G. E. A.

1225. Physiological Effect of Several Sources of Sound on the Ear and Its Consequences in Architectural Acoustics. F. Aigner and M. J. O. Strutt. *Acoustical Soc. of America, J.* 6. *pp.* 155–159, *Jan.*, 1935.—In a large room three loud speakers were placed; two were connected to the same radio set, and the third to a second radio set giving different quality of tone. The radios were tuned to the same station and levels adjusted so that at the observing positions each speaker produced about 60 db. It was found that two sources of identical tone quality with or without phase difference lead to energy addition in estimating their resultant effect. Also if two sources of different tone quality are heard without phase difference, energy addition again occurs. the increase being 3 to 4 db. But if the two sources have different tone qualities, and there is a time shift or difference in time of arrival of the sounds at the ear, the increase in level is from 10 to 12 db. This was verified for different rooms, different kinds of music, and when gramophones were used instead of radio sets. The explanation is based on the inertia of the ear. Some applications of the results to room acoustics are mentioned and a Bibliography is appended. G. E. A.

***1226. High-Speed Sound-Level Recorder Measurements. E. C. Wente, E. H. Bedell and K. D. Swartzel, Jr.** *Acoustical Soc. of America, J.* 6. *pp.* 121–136, *Jan.*, 1935.—It is sometimes highly desirable that records of sound level cover a range of at least 60 db. The level recorder described here consists essentially of an amplifier and rectifier, the output current of which is held at a substantially constant value automatically by a change in the gain of the amplifier, following changes in input power. The gain is varied by means of motor-driven slide-wire potentiometers graduated in logarithmic steps, the gain settings of which are recorded. Records are reproduced showing the application of the recorder to measurements of modulated 1000-cycle input voltage (modulation frequency continuously increasing), level variations in speech and pianoforte music, decay of undamped and damped tuning-fork, street noise, loud-speaker and microphone response, output characteristic of heterodyne oscillator, transmission characteristic of 100- to 5500-cycle band-pass filter, harmonic resonance in an air-column, and portions of superimposed records of orchestral music played on successive days. Reverberation time and absorption measurements are studied in extended detail. J. E. B.

***1227. Applications of Modern Acoustic Apparatus. S. K. Wolf and W. J. Sette.** *Acoustical Soc. of America, J.* 6. *pp.* 160–168, *Jan.*, 1935.—Specific applications of the recently developed automatic level recorder, crystal analyser, and acoustic spectrometer to the study of reverberation, and loudspeaker response measurements, noise and piano tone analyses, and studies of the singing voice follow a brief account of the operating characteristics of the instruments. The automatic level recorder ideally measures sound decay in auditoria and reverberation chambers, giving a continuous record of the decay in db., as a function of time, an outstanding advantage over previously available means. The crystal analyser is usually used jointly in order to suppress extraneous noises, thus extending the length of the measurable decay. Harmonic analysis of piano tone is complicated by the fact that the tone is in the nature of a shock excitation, the various partials decaying at their own rates; so that thorough analysis requires a complete history of decay for all the partials, properly phased with respect to each other. J. E. B.

See also Abstracts 1248, 1287.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***1228. Sixty-Cycle Wave Recorder. W. F. Westendorp.** *Rev. Sci. Instruments*, 6. *pp.* 50–54, *Feb.*, 1935.—A semi-automatic wave recorder has been developed for small alternating voltages in synchronism with the 3-phase power supply. The device has an input impedance of more than 250,000 ohms and records directly on metric paper so that 1 cm. = 1 volt and 18 cm. = 1 cycle = 360°. About one minute of the operator's time is required to plot a complete curve. AUTHOR.

CONDUCTION AND DISCHARGE IN GASES.

***1229. Application of Wilson Chamber to Study of Spark Discharge. U. Nakaya and F. Yamasaki.** *Roy. Soc., Proc.* 148*A*. *pp.* 446–453, *Feb.* 1, 1935.—The authors studied the formation and distribution of ions produced at the initial stages of spark formation by the use of the Wilson chamber. For keeping the ions in the position where they were produced, a surge was sent from an ordinary impulse generator to the electrodes enclosed in the chamber, and its front was cut down by a spark discharge through a secondary gap l inserted parallel to the electrodes. By varying l the successive stages of formation of ions could be seen in the preliminary stage of a spark. The voltage impulse was sent just after the expansion of the chamber was completed and an illuminating spark was passed a few hundredths of a second after the impulse was applied, the synchronisation having been done by a pendulum. The tracks of the ions were photographed by this method, and it was found that the ion cloud from the negative electrode was spindle-shaped and of a diffuse character, while that from the positive electrode was composed of thin streamers of well-defined form. Photographs of ion clouds for various conditions were reproduced. AUTHORS.

1230. Intensity of H.F. Electrodeless Discharge, as Conditioned by Power Control of the Generator. O. Stuhlman, Jr., and M. S. McCay. *Frank. Inst., J.* 219. *pp.* 37–46, *Jan.*, 1935.—The work here described is concerned with the excitation of hydrogen when it produces a uniform glow discharge due to its presence at low, constant pressure, in a h.f. electric field. The frequency range investigated was from 5·0 to 7·5 megacycles. The hydrogen was caused to glow in tubes 2 cm. in dia., at pressures in the neighbourhood of 250 microns. The glow discharge at these pressures was of a bluish pink colour, with the molecular spectrum more intense than the Balmer lines. The Fulcher lines were very prominent. At low field-strengths the Balmer lines were just visible and increased in intensity with increase of field strength, thus gradually contributing the characteristic rose-coloured glow to the gas. The intensities of the α and β lines were measured at predetermined frequencies for various increasing magnitudes of the current flowing through the solenoid surrounding the discharge tube and simultaneous observations were made of changes in the power supplied to the oscillators after the glow discharge had started and thermal equilibrium had been established. The results obtained lead to the conclusion that the intensity per unit field-strength is a linear function of the frequency. A. W.

1231. Polymerisation of Liquid Hydrocarbons under the Action of Electric Discharges. G. Tarasov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 398–403, *Dec.* 1, 1934. *In English.*—It is pointed out that there is little recorded on this subject and the present paper deals with the influence of electric discharge on the viscosity of the polymerised product, all other conditions such as temperature and pressure being constant. The work was carried out in an apparatus similar to a Siemen's ozoniser and the initial product chosen was cracking kerosene from the Winkler-Kock plant. Currents of 350, 500, 750, 1000 and 2000 cycles per second with an operating voltage at the outgoing transformer of from 4·0 to 14·0 kV. were employed. It is concluded that to produce an appreciable qualitative change in the process, as measured by viscosity, it is necessary to effect a much greater change in the conditions of electric discharge. J. K.

***1232. Falling Cloud-Chamber and Radial-Expansion Chamber. C. T. R. Wilson and J. G. Wilson.** *Roy. Soc., Proc.* 148*A. pp.* 523–533, *Feb.* 15, 1935.—The advantages of removing a cloud-chamber from a confined space such as that between the poles of a magnet by letting it fall and photographing the tracks while the chamber is falling freely, are pointed out. A new type of cloud chamber is described which has the form of a shallow cylinder with plane glass ends and in which the motion of the air during expansion is radial. Experiments show that this type of chamber gives good results. It is found, as anticipated, that dropping the cloud-chamber and photographing while it is falling freely enables undistorted track pictures to be obtained (by eliminating gravity) when the interval between expansion and illumination is prolonged to such an extent that, with the cloud-chamber stationary, distortion by convection currents has become serious. AUTHORS.

***1233. High-Intensity Discharge Tube. D. S. Stevens.** *Rev. Sci. Instruments,* 6. *pp.* 40–42, *Feb.*, 1935.—A high intensity discharge tube is constructed by placing a small constriction in a d.c. arc. The d.c. is supplied by mercury vapour rectifiers. The tube has been operated with the rare gases, oxygen, hydrogen and nitrogen. With hydrogen the ultra-violet continuous spectrum is very strong and this tube should be a good source for absorption spectra in that region. The use of a wedge lens is also described. AUTHOR.

See also Abstracts 1097, 1114, 1182, 1201, 1239, 1296.

CONDUCTION IN SOLIDS AND LIQUIDS.

***1234. Rectifying Peak Voltmeter as a Standard Instrument. A. T. Starr.** *Phys. Soc., Proc.* 47. *p.* 184, *Jan.* 1, 1935.—Addendum to paper previously published [see Abstract 311 (1934).]

1235. Current Fluctuations in a High Resistance. G. W. Barnes. *Frank. Inst., J.* 219. *pp.* 100–107, *Jan.*, 1935.—A commercial 10 megohm "metallised" resistance was arranged with three wire-wound resistances to form a Wheatstone bridge circuit. By valve amplification, fluctuations in the current and their dependence on the magnitude of the current flowing in the metallised resistance, were demonstrated with a short period galvanometer. Conduction appears to take place by leaps of groups of about 70 electrons between aggregates of molecules in the metallic film and the observed fluctuations are shown to be in agreement with probability considerations. F. C. C.

1236. Electron Theory of Supraconductivity. R. Schachenmeier. *Zeits. f. techn. Physik*, 15. 12. *pp.* 542–544; *Disc.*, 544–545, 1934. *Phys. Zeits.* 35. *pp.* 966–968; *Disc.*, 968–969, *Dec.* 1, 1934.—Employing the author's theory of supraconductivity which postulates a lattice of atoms each possessing at least two electrons exterior to the outermost closed shell, it is shown that the conduction electrons in the degenerate region of the energy spectrum, which are responsible for supraconductivity, correspond to wave functions which to a first approximation are unmodified by an external magnetic field. It follows that the current direction in supraconductivity is unaffected by a magnetic field, in accordance with the results of experiments by K. Onnes. In the *Discussion*, **A. R. Sommerfeld** observed that if the alkali metals should be found to show supraconductivity, Schachenmeier's theory would be faced by a serious difficulty. W. S. S.

See also Abstract 972.

DIELECTRICS AND CAPACITANCE.

1237. Potential Distribution Between Parallel Plates and Concentric Cylinders Due to Any Arbitrary Distribution of Space Charge. W. G. Cady. *Physics*, 6. *pp.* 10–13, *Jan.*, 1935.—Equations are derived for the electric potential and field intensity due to a distribution of space charge in a slab of dielectric between two infinite parallel conducting plates. The charge density may be any integrable function of the coordinate perpendicular to the plates. The corresponding solution for concentric cylinders is also given. A number of special cases are discussed, including that of a uniformly-distributed charge, and one of sinusoidal distribution. The latter has an application in the theory of the piezoelectric resonator. AUTHOR.

***1238. Measurement of Dielectric Constants. A. Büchner.** *Zeits. f. techn. Physik*, 16. 1. *pp.* 10–12, 1935.—To avoid the necessity of h.f. measuring instruments in the determination of dielectric constants, the use of the emittor also as a tube-voltmeter is suggested. In measuring the dielectric constant of a plate, errors are introduced by the uncertainty in the calculation of the empty-capacity owing to the lines of force running partly in the dielectric and partly in the air. With plates covered to the edges with lagging, it is shown that the empty-capacity may be accurately calculated by Kirchhoff's formula. T. H. P.

1239. Dielectric Constant and Conductivity of Ionised Gases. T. V. Ionescu and C. Mihul. *J. de Physique et le Radium*, 6. *pp.* 35–48, *Jan.*, 1935.—The authors, having performed a series of experiments and measurements on ionised gases during the years 1929–32, some of which have already been published [see Abstract 2524 (1933)], here give a *résumé* of the work on this subject. They then give the results of tests made on various ionised gases between the plates of a condenser subjected to a h.f. electric field varying between $1{\cdot}5 \times 10^8$ p.p.s. and $7{\cdot}5 \times 10^6$ p.p.s., together with the theory of the method and the experimental details. It is shown that the variation of the capacity ΔC and the conductance $1/\rho$ are due to two types of electrons (1) free electrons, according to the formulæ:

$$\Delta C = -C\,\frac{Ne^2\lambda^2}{\pi m c^2}\left[1 - \frac{\sin\omega T}{\omega T}\right] \text{ and } \frac{1}{\rho} = \frac{Ne^2\lambda^2}{\pi m c^2}\left[1 - \cos\omega T\right]\frac{C}{T}$$

which have been verified quantitatively, and (2) those which have a natural frequency (1/3) × 10^8 p.p.s. The variations of Δ C and $1/\rho$ have been studied for cases where the electrons are in an electric field and also in a magnetic field and the following conclusions are reached; (*a*) considerable changes in the variation of Δ C and $1/\rho$ due to the free electrons are caused by an electric field; (*b*) the free electrons are separated from the natural frequency electrons by a magnetic field. For free electrons $1/\rho$ passes through a maximum at $\omega = eH/m$ whereas for natural frequency electrons the maximum is at $\omega' = e\,(H - H_0)/m$, where H_0 is a constant. The natural frequency can be explained by assuming that in the experiments there are electrons attached to the O_2 molecules, and that these precess in the magnetic field H_0 of the molecule with a frequency equal to the natural frequency of the gas. The evidence is supported by the effect of humidity on the variation of $1/\rho$ for natural frequency electrons. The variations of Δ C and $1/\rho$ have been studied for pressures greater than 10^{-3} mm. Hg and that for pressures greater than 10^{-2} mm. Hg all the gases studied exhibit a natural frequency. R. L.

1240. Dipole Moments and Molecular Structure of Amides. W. D. Kumler and C. W. Porter. *Am. Chem. Soc., J.* 56. *pp.* 2549–2554, *Dec.*, 1934.—Measurements have been made of the dipole moments of acetamide, its mono- and di-alkyl derivatives, ethylacetimino ether, and *p*-nitroaniline. The use of bond and group moments in the calculation of moments of resonating compounds is discussed and an explanation, based on resonance, is advanced for the high moment of *p*-nitroaniline and for the differences between the moments of simple aromatic and aliphatic compounds. Evidence is given to show that amides are resonating compounds, and that the unsubstituted amides do not exist to a very large extent in the form OH·CR:NH. From the moment of ethylacetimino ether the value of the moment of the C:N bond is calculated to be 1·6. T. H. P.

1241. Dipole Moments of Associated Molecules. E. Hertel and E. Dumont. *Zeits. f. phys. Chem.* 28. *Abt.B.* 1. *pp.* 14–16, 1935.—Sakurada [see Abstract 1297 (1934)] has proposed a method which, from the usual dielectric data for a substance mixed with a dipole-free partner, which he claimed would enable the calculation of the magnitudes of the dipole moments of associated molecules and by which the validity of the mass action law during association was established. The present authors question the rigid character of Sakurada's work, which they assert does not justify definite conclusions being drawn from it. The authors also opine that it is doubtful whether the mass action law can be considered valid over the whole range of concentration from 0 to 100 % without further information, quite apart from the possibility of induced dipole moments and from the behaviour of dilute solutions, both of which subjects have not been treated by Sakurada. H. H. Ho.

1242. Effect of Illumination on the Electrical Breakdown Strength of Rock-Salt Activated by X-Rays. A. Worobjew. *Zeits. f. Physik*, 93. 3–4. *pp.* 269–277, *Jan.* 4, 1935.—Series of experiments are described which were made to determine the breakdown strength of activated rock-salt crystals of various thicknesses immersed in different organic liquids and illuminated with light of various wave-lengths for periods down to 1/70th sec. It was found that the breakdown strength of the rock-salt crystals was reduced by illumination, and that this reduction depended on the intensity and not on the wave-length of the light. A tentative theoretical explanation is advanced, but the author recommends further experiments. R. L.

1243. L.F. Polarisation Capacity of Mercury Electrode. N. Thon. *Comptes Rendus*, 200. *pp.* 54–56, *Jan.* 2, 1935.—The capacity of the Hg electrode has been determined (with $0 \cdot 5$-N LiCl as electrolyte) for very low frequencies (9 and 32 sec.$^{-1}$, with periods of change of $1 \cdot 85 \times 10^{-2}$ and $5 \cdot 4 \times 10^{-3}$ respectively). The results show complete independence of the frequency, and agreement between the calculated capacities whether based on kathodic or anodic polarisation, thus supporting results deduced from the electrocapillary curve, but contrary to those of Erdey-Gruz and Kromrey [see Abstract 1455 (1932)]. The values measured are therefore the true capacities of the Hg|soln. double layer. [See Abstract 3402 (1934).] C. A. S.

See also Abstract 1266.

ELECTROCHEMISTRY.

1244. Combustible Material Cells with Working Temperatures below 600° C. S. Tamaru and M. Kamada. *Zeits. f. Elektrochem.* 41. *pp.* 93–96, *Feb.*, 1935.—Almost all eutectic mixtures of K_2CO_3, Na_2CO_3 and an alkali halide serve as electrolytes for combustible material cells at 550–600° C., and the eutectic mixture of Na_2CO_3, K_2CO_3 and Li_2CO_3 at 400–550° C. Most of the polarisation of cells consisting of metal-air electrode and carbon anode occurs at the air electrode at 550–600° C., and at both electrodes at 400–500° C. Experiment shows that the reaction in the cell is the same as for combustion of carbon in the air. As depolariser, manganate is especially active for the cell (Pt, Pd, Au or Ag) |O_2eutectic mixture|C and boric acid-copper oxide for the cell (Cu)O_2|eutectic mixture| C. A practical form of the cell is described in which carbon is supplied as powder. The reaction-mechanism of the cells is explained and the e.m.f. is compared with the free energy of the reaction. [See Abstract 2584 (1933).] T. H. P.

1245. Overvoltage Theory and General Discharge of Ions. O. Essin. *Zeits. f. phys. Chem.* 171. *Abt.A.* 5–6. *pp.* 341–347, 1934. —Volmer's theory of over-voltage is applied to derive the equation for the distribution of current between different ions simultaneously discharged at electrodes, both for reversible and irreversible electrolysis. The result is applies to various results obtained by Creutzfeld, Röntgen and Högel, Fedotieff, and Abegg for the simultaneous discharge of ionic pairs of metals and hydrogen. J. S. G. T.

1246. Electrolysis of Sodium Chloride in Liquid Ammonia. E. I. Achumow and B. B. Wassiliew. *Zeits. f. Elektrochem.* 41. *pp.* 96–101, *Feb.*, 1935.—The electrical conductivity of solutions of NaCl in liquid NH_3 is a function of the solubility, the maxima of the two magnitudes corresponding. In agreement with the value calculated from Thomson's formula, the decomposition voltage of NaCl is determined experimentally to be $3 \cdot 54$. Electrolyses were carried out at the temperature of maximum solubility in a steel autoclave, which served as kathode. The anode was of graphite, and the anode and kathode chambers were separated by an asbestos diaphragm. The products formed were NH_4Cl at the anode and $NaNH_2$ at the kathode. T. H. P.

1247. Electrolytic Conductance by Proton Jumps. Transference Number of Barium Bisulphate in the Solvent Sulphuric Acid. L. P. Hammett and F. A. Lowenheim. *Am. Chem. Soc., J.* 56. *pp.* 2620–2625, *Dec.*, 1934.—There is shown to be a small but real migration of the Ba ion in $BaSO_4$ solutions in H_2SO_4. The apparent transference number of the Ba ion in these solutions is 0·012; by using the non-electrolyte trichloracetic acid as reference solute the true transference number is found to be about one-half of this. The process of conduction in these solutions cannot depend on a simple ionic migration, a conclusion strongly supporting the theory of conduction by intermolecular proton jumps which has been suggested as an explanation of the anomalous mobilities of H and OH ions in aqueous solutions. N. M. B.

1248. Acoustic-Electrochemical Phenomena. L. Nikitin. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 309–313, *Nov.* 21, 1934. *In German.*—Experiments are described which show that sound energy incident on a polarised electrode in a corresponding electrolyte can give rise to variations of the electrode potential with the frequency of the incident sound waves. This effect is probably to be explained by the periodic building up of a gas layer, which gradually forms and then suddenly disappears. A. W.

1249. Electrochemical and X-Ray Investigation of Solid Thallium Amalgams. A. Ölander. *Zeits. f. phys. Chem.* 171. *Abt.A.* 5–6. *pp.* 425–435, 1934.—Electrode potentials of sixteen Tl amalgams containing 20–30·5 % Tl, were determined at temperatures − 75° − 20° by means of cells | 55 % Tl amalgam | TlOAc in EtOH | 20–30·5 % Tl amalgams |, and the temperature coefficients thence deduced. The results negative the existence of Tl_2Hg_5, favouring that of $TlHg_2$. This conclusion is supported by X-ray examination which shows these amalgams to have a face-centred cubic lattice (a 4·664 Å for the 29 % Tl amalgam). The phase has no transition point below its m.p. The $\alpha \rightarrow \beta$ transition point of Tl is lowered from 234° to 222°, 192·5°, and 151° by addition of 0·44, 1·5 and 2·7 % Hg respectively. Amalgams containing 86–90 % Tl have a body-centred cubic lattice. C. A. S.

1250. Azide Potentials. E. H. Riesenfeld and F. Müller. *Zeits. f. Elektrochem.* 41. *pp.* 87–92, *Feb.*, 1935.—A Pt-anode in NaN_3 solution assumes a definite potential, determined by the process: $N_3^1 \rightarrow N_3 + \theta$; $N_3 \rightarrow N_2 + N$; $N + N \rightarrow N_2$. Change of the potential with current density corresponds with Tafel's formula, $n = a + b \log I$. Measurements with smooth and platinised Pt show that $b = RT/F \log e$, in accordance with Volmer's theory. With smooth Pt electrodes at 0° C. the potential is 1·211 volt towards the normal H-electrode. At platinised Pt, the value is 0·06 volt lower, the process $N_3 \rightarrow 1\frac{1}{2} N_2$ being accelerated. With electrodes of Ir, pure Ni and Fe, the potentials are almost the same as with smooth Pt, but the value of b indicates that other processes here affect the potential. At smooth Pt the temperature coefficient of the e.m.f. is − 0·0017 volt/1° C. Ag anodes coated electrolytically with AgN_3 show a reversible potential determined by the process AgN_3/N_3^1; at 21° C. this is + 0·384 volt towards the normal H-electrode, and the temperature coefficient is + 0·0006 volt/1° C. The solubility of AgN_3 in water, measured by means of a Ag-ion concentration cell, is $8 \cdot 4 \times 10^{-3}$ gm./l. at 18° C. T. H. P.

See also Abstracts 948, 1243.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

1251. Electric Moment of an Electron. A. Lees. *Cambridge Phil. Soc., Proc.* 31. *pp.* 94–98, *Jan.*, 1935.—It is well known that an electron possesses a magnetic moment. Frenkel has further deduced by relativistic arguments that the electron must also possess a real electric moment [see Abstract 2371 (1926)]. Dirac has deduced, from his linear wave equation [see Abstract 1168 (1928)], a relation which indicates formally the existence of an imaginary electric moment as well as the real magnetic moment. It is shown that Frenkel's argument is not sound, since it is now known that a relativistic state of affairs may not admit of tensorial representation, and that Dirac's reasoning is not sufficiently precise. When it is replaced by precise reasoning the magnetic moment remains as before, but the terms representing the electric moment disappear from the result. The electric moment therefore does not exist. AUTHOR.

1252. Production of Positrons by β-Rays. D. Skobelzyn and (Miss) E. Stepanowa. *J. de Physique et le Radium*, 6. *pp.* 1–11, *Jan.*, 1935.—Study of the β-radiation emitted by a radioactive source ($RaBr_2$) was made by employing a Wilson chamber: 1650 pairs of stereoscopic photographs being examined. The bundle of rays sent out from the source, which was placed in the expansion chamber surrounded by a magnetic field, passed through a slit and traversed different screens. The experiments showed that the passage of β-rays from RaC across sheets of carbon, celluloid and lead is accompanied by the production of positrons, and 130 trajectories of these, deviated in magnetic fields of about 400 gauss, were observed. On analysis of the statistical distribution of the velocities it is possible to conclude that in the interval of energy examined the intensity of the emission is inversely proportional to the square of the positron energy, the mean energy being of the order of 100 KVe. The "efficacious section" of the atom of lead determining the mean probability of production of the positrons by the β-particles, of which the energy is comprised between 1 and 3 million volts is of the order of 10^{-22} (cm.)^2. The efficacious section seems to be proportional to the atomic number. It is not possible to produce agreement between the facts observed and the deductions from the usual theory of production of pairs, that is, the theory based on the conceptions of the "holes" of Dirac. J. J. S.

***1253. Time-Marking a Kathode-Ray Oscillograph by Harmonics. L. F. Richardson.** *Phys. Soc. Proc.* 47. *pp.* 258–262, *March*, 1935.—A docile time-marker was arranged in which the oscillograph acted also as a triode giving retroaction in a tuned circuit where one of the harmonics of the trace-frequency was selected and applied to the Wehnhelt cylinder so as to modulate the focus of the trace. AUTHOR.

1254. Energy Levels of Electrons in Amorphous Bodies. V. Ždanov. *J. de Physique et le Radium*, 5. *pp.* 614–616, *Dec.*, 1934.—The author derives a general formula for the correction of the energy of an electron forming part of a body, without reference to the nature of the body. Applications to the case of crystalline and of completely amorphous bodies lead respectively to the energy spectrum of Bloch and to a displacement of the level relative to that of an isolated atom. If the atoms of an amorphous body are not situated in widely differing orientations, all the values of the energy level will be near one another, giving a small enlargement of the level and not a broad zone. T. L. M.

1255. Electron Transference Processes in the Mechanism of Oxidation and Reduction Reactions in Solutions. J. Weiss. *Naturwiss.* 23. *pp.* 64–69, *Jan.* 25, 1935.—The investigation of various simple oxidation and reduction reactions in solution shows that the elementary processes consist of simple electron transferences, in which also uncharged particles take part. With all these processes as yet examined, only one electron is transferred in an elementary process, and this monovalent course is often found also in cases where one proton or one H-atom participates in the reaction. The rôle of electron transference in the following reactions is considered: the catalytic decomposition of H_2O_2 in solution and by metallic ions; the oxidation of ferrous salts by O_2; the similar oxidation of leuco-bases or hydroquinone. The bearing on electron transference processes of the paramagnetic properties of ions of Fe, Co, Ni and Mn is also discussed. Preliminary results indicate the probability that simple electron transference processes play a large part also in the reactions of organic chemistry. T. H. P.

See also Abstracts 998, 1001.

ELECTROSTATICS.

1256. Surface Charge in Beeswax during Solidification and in the Solid State. P. Jaeger. *Ann. d. Physik*, 21. 5. *pp.* 481–502, *Dec.*, 1934.—Investigation of the solidification of beeswax under p.d. of 10 and 20 kV shows considerable surface charges and total charges. The test materials were cut into layers parallel to the electrodes, and when this procedure was applied to the solid wax immediately after setting, the results obtained varied with the direction of the p.d., owing to irregular cooling of the test pieces. When this procedure was omitted, satisfactory results were obtained at room-temperature and the presence of total charge was indicated. T. H. P.

1257. Splashing of Water in an Electric Field. J. P. Gott. *Cambridge Phil. Soc., Proc.* 31. *pp.* 85–93, *Jan.*, 1935.—A detailed account is given of the appearances observed when drops of water 1·5–2·5 mm. radius, fall from various heights $\ngtr$ 120 cm., into deep water under the influence of a vertical electric field of varying strength $\ngtr$ about ± 5200 V/cm. The smallest drops in the spray thrown up by a splash just begin to rise towards the upper plate in fields of about 300 V/cm., *i.e.* slightly > the field observed at the earth's surface in a thunderstorm. The charge of such a drop is of the order 1000 e.s.u./cc., and its radius < about 0·5 mm. C. A. S.

See also Abstracts 1055, 1056, 1237.

MAGNETISM AND ELECTROMAGNETISM.

1258. Solution of a Plane Problem in Magnetism. A. Svetlov and V. Stroganov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 113–118, *Oct.* 21, 1934. *In French.*—A preliminary communication which deals with the problem of the magnetisation of a homogeneous body for which $\mu > 1$ and constant. The authors set out to find harmonic functions V and V_1 for the spaces respectively outside and inside a closed curve, under the conditions that $V = V_1$ at the boundary, and $\partial V/\partial n_e + \mu \partial V_1/\partial n_i = (\mu - 1)f$, where n_e and n_i are normals drawn to the outside and inside of the curve, and f is a function such that $\int f dl = 0$ over the curve. The method of solution by transformation is indicated, and is applied to the case of the magnetisation of a prism of rectangular section in a field of unit intensity. G. E. A.

1259. Magnetic Researches on Precipitable Fe-Ni Alloys. F. Preisach. *Zeits. f. Physik,* 93. 3–4. *pp.* 245–268, *Jan.* 4, 1935.—The alterations in the physical properties of an alloy which occur in the process of precipitation hardening are reviewed and the importance of a close study of the phenomenon in ferromagnetic alloys is pointed out. The physical properties of 2 alloys, one containing 55 % Ni and 45 % Fe and the other 38 % Ni and 46 % Fe are examined. To the former an addition of 1 % Be is made to act as a precipitant and to the latter 15 % Cu and 1 % Mn. Measurements are made on the alloys in the annealed and cold-worked state and the mechanism of precipitation hardening in them is discussed fully. H. J. H. S.

1260. Directions of Discontinuous Changes in Magnetisation in Si-Fe Monocrystal Bars and Discs. R. F. Clash, Jr., and F. J. Beck, Jr. *Phys. Rev.* 47. *pp.* 158–165, *Jan.* 15, 1935.—The previous work of Beck and McKeehan is revised and extended by a much-improved method. A kathode-ray oscillograph is used to impress the two amplified component impulses upon an electron beam, thus re-integrating the components into a vector representing the nearly discontinuous increment in magnetisation. The movements of the spot on the fluorescent screen then represent two-dimensional reconstructions of the initial discontinuous increments in magnetisation. Bars and discs of Si-Fe single and polycrystals are used. The crystallographic dependence of the Barkhausen effect is shown by plotting the azimuth of the differential field vector against the angle between the differential field vector and the increment in magnetisation. Certain peculiarities are observed and a tentative explanation is suggested from the results of previous workers. H. J. H. S.

1261. Susceptibility Constants for Coordinate Linkage in Addition Compounds. Part I. S. S. Bhatnagar, M. R. Verma and P. L. Kapur. *Indian Journ. Phys.* 9. *pp.* 131–139, *Nov.,* 1934.—Magnetic susceptibility was studied in those molecular compounds in which the existence of coordinate linkage has been shown to be probable. The compounds were those formed by the interaction of a nitro-compound and an amine or a hydrocarbon. The susceptibilities of the original components were first determined, then those of the compounds, and it is found that the addition compound becomes more diamagnetic than should be expected on the additivity law. The increase has a value between 77×10^{-7} and 140×10^{-7} per gm. mol. This result is discussed. G. E. A.

1262. Magnetic Susceptibility of Some Alloys of γ-Brass Structure. C. S. Smith. *Physics,* 6. *pp.* 47–52, *Jan.,* 1935.—The change of diamagnetic susceptibility with composition of a number of phases of γ-brass structure (Cu-Zn, Cu-Cd, Ag-Zn, Ag-Cd) has been determined. In each case when the phase makes its first appearance with low electron ratio, it is not strongly diamagnetic, but the increase in diamagnetism is approximately linearly dependent on the number of free electrons, and the strongest diamagnetism occurs at the limit of the γ-phase with the highest electron ratio possible for the structure. AUTHOR.

1263. Diamagnetism of Mercury Crystals. E. Vogt. *Ann. d. Physik,* 21. 8. *pp.* 791–803, *Jan.,* 1935.—The dependence of diamagnetism upon direction relative to the crystal axis is investigated for single crystals of Hg prepared by Grüneisen and Sckell. The anisotropy of the mass susceptibility χ is found to be $\chi_\perp - \chi_\parallel = -8\cdot9\ (\pm 0\cdot2)\cdot10^{-9}$, the absolute values being $\chi_\perp = -121(\pm 2)\cdot10^{-9}$ and $\chi_\parallel = -112(\pm2)\cdot10^{-9}$. Hg crystals are thus more weakly diamagnetic than liquid Hg. The results are compared with those observed for other metals (especially Zn and Cd) and the relationships of magnetic properties to crystal structure are discussed. L. A. W.

1264. Paramagnetism in the Palladium Series. B. Cabrera and H. Fahlenbrach. *Ann. d. Physik*, 21. 8. *pp.* 832–840, *Jan.*, 1935.—With a highly sensitive torsion balance measurements were made in an inhomogeneous magnetic field of the absolute value of the susceptibility of $RhCl_3$ and $PdCl_2$. The value of $\chi_m \times 10^6$, where χ_m = the molecular susceptibility was found to be $-12\cdot10$ for $RhCl_3$ and $-37\cdot97$ for $PdCl_2$. The dependence on temperature of the susceptibility was also measured for $PdCl_2$, $RhCl_3$ and $RuCl_3$ and the results are given in a series of tables. The chlorides of the palladium family tested appear magneto-thermally to obey a law of the form $(\chi + a)T = C$, where χ is the susceptibility, T temperature, and a and C are constants. In aqueous solution $PdCl_2$ behaves fundamentally otherwise than would be expected according to the magnetic theories. J. J. S.

1265. Magnetic Properties of Amorphous Manganese. L. F. Bates and D. V. R. Pantulu. *Phys. Soc., Proc.* 47. *pp.* 197–204, *March*, 1935.—A description is given of the preparation *in vacuo* of pure amorphous manganese. It is found to be paramagnetic, without trace of ferromagnetism, and to obey the Curie-Weiss law, $\chi = 2\cdot174 \times 10^{-2}/T + 1540$, over the range of temperature 90 to 600° K., the experimental value of χ at 20° C. being $11\cdot80 \times 10^{-6}$. AUTHORS.

1266. Electrodynamics of Moving Bodies. K. F. Herzfeld. *Ann. d. Physik*, 21. 7. *pp.* 743–744, *Jan.*, 1935.—Bünger has shown by direct measurement that the capacity of a condenser is independent of its orientation with respect to the direction of motion [see Abstract 5254 (1934)]. It is here pointed out that the research of Trouton and Noble gives the same result with greater accuracy. A. W.

1267. Magnetostriction of Pure and Alloyed Bi Single Crystals. A. Wolf and A. Goetz. *Phys. Rev.* 46. *pp.* 1095–1107, *Dec.* 15, 1934.—Magnetostrictive effects in nonferromagnetic substances have been produced by large transient currents [see Abstract 3435 (1932)]. It is shown to occur for steady fields of moderate value (20 to 25 kilogauss) in Bi single crystals and crystals with dissolved foreign atoms. The modulus of magnetostriction m is defined from $\Delta l/l = \frac{1}{2}\, m\, H^2$. For pure Bi crystals, $m = +5\cdot7 \times 10^{-16}$ (elongation) parallel to the trigonal axis, and $m = -7\cdot0 \times 10^{-16}$ (contraction) normal to the same axis. The effect of the addition of Pb, Sn and Te to the Bi crystals was also studied in continuation of previous work [see Abstract 1731 (1934)]. Sn and Pb at first cause diminution of contraction normal to the trigonal axis and with increasing concentrations they cause an elongation. Parallel to the axis small Sn content decreases the elongation, but large concentrations increase the elongation. The Pb effect is small. Te produces a much larger specific effect but no change in sign. With regard to the influence of foreign atoms on the susceptibility, it is concluded that the results justify the assumption of the existence of two types of insertion of foreign atoms in the crystal lattice, *viz.*, selective adsorption for small concentrations, and volume absorption for larger concentrations. G. E. A.

***1268. Apparatus for Measuring Magnetic Susceptibility at High Temperatures. R. B. Sosman and J. B. Austin.** *Washington Acad. Sci., J.* 25. *pp.* 15–32, *Jan.* 15, 1935.—Describes a magnetic balance in which the force on a solid or liquid specimen in a non-uniform magnetic field is measured by direct weighing. The specimen in a celluloid, glass or gold container is suspended from the balance arm on the axis of two concentric vertical solenoids which can be arranged to vary the field while maintaining a constant vertical field gradient. An absolute calibration by calculation from the solenoid dimensions agreed within 1 % with an empirical calibration using ferrous ammonium sulphate as a standard. Mass susceptibility can be measured within about 1×10^{-7} on a 10 gm. specimen. An electric furnace gives temperatures up to 1000° C. with a zone of approximately constant temperature 3 cm. long. C. E. W.

See also Abstracts 990, 998, 1141, 1220.

MEDICAL RADIOLOGY AND ELECTROLOGY.

1269. Electric Potentials from the Intact Human Brain. H. H. Jasper and L. Carmichael. *Science*, 81. *pp.* 51–53, *Jan.* 11, 1935.—Experiments are described in which amplifier-oscillograph records are made of the vibrating voltages obtained when electrodes are placed in contact with the human head. In all cases the vibrations could be divided into two series, the first (α-waves) having an amplitude of 20 to 80 μV and a frequency of about 8 to 12 $\sim$, the others having an amplitude of 15 to 30 μV and a frequency of 25 to 50 $\sim$. The waves appear at maximum amplitude when the subject is relaxed, stimuli, such as that of light, changing appreciably the magnitude and frequency of the oscillations. Pathological conditions also appear to modify the observed frequency. There is some evidence to support the theory that the large oscillations are the end result of voltages built up by several smaller oscillations at different frequencies. J. E. R.

***1270. H.F. Resistance of Biological Materials. H. Dänzer.** *Ann. d. Physik*, 21. 8. *pp.* 783–790, *Jan.*, 1935.—In a previous paper [see Abstract 4731 (1934)] a formula, based on Wagner's theory of inhomogeneous dielectrics, is developed for the h.f. conductivity of biological materials, such as blood. Experiments are now carried out to test the theory. A detailed description is given of apparatus designed to measure resistances over a range of wave-lengths from 50 cm. to 700 m. In the wave-length region 50 cm. to 14 m. the conductivities observed are much higher than those found by Schäfer. A curve showing the variation of specific resistance with wave-length is given, in which there is a rapid rise in the region of 100 m. to 200 m. The experimental results are in good agreement with the previously developed theory. J. E. R.

1271. Practical Applications of Lapicque's Progressive Currents in Electro-Diagnosis and Electrotherapy. P. Duhem. *J. de Radiologie et d'Électrologie*, 18. *pp.* 601–611, *Dec.*, 1934.—Lapicque currents are capacitative currents, normally occurring when a capacitative circuit is made or broken. These have been applied in electro-medicine, since 1891, when they were first utilised by d'Arsonval. When the pathological nervous condition, known as the reaction of degeneration, is present there is a selected response of muscles to electrical excitation by these currents. This fact has been utilised by the author, a capacitative circuit being shown suitable for the purpose, which allows variation of the electrical constants, by insertion of capacities of various values, at choice. In cases of certain diseases, owing to nervous injury, certain groups of muscles, may be paralysed and it is necessary, for curative purposes, to stimulate their contraction. By the use of Lapicque currents these muscles may be made to contract, without associated muscles responding as is not desired, examples being given by the author in respect to muscles of the lower leg, showing that various surgical deformities can be artificially induced by application of these currents, and, conversely, for therapeutic purposes these deformities may be corrected, since they are due to excessive opposing tension of sound muscles, over the tension of the weakened defective muscles, the currents stimulating contraction in the defective muscles, without stimulating contraction in the sound muscles. The application of these currents is therefore not only in respect to the determination of muscles affected by disease, but to stimulate their contractions, with therapeutic improvement and cure. B. J. L.

1272. Diminution of Neuro-Muscular Excitability by d'Arsonval Currents. L. Delherm and H. Fischgold. *Comptes Rendus*, 199. *pp.* 1688–1690, *Dec.* 26, 1934.—The experiments of d'Arsonval on the biological effects of h.f. currents have been repeated, with a view to investigating the analgesic effects of the currents. It is shown that during the passage of the h.f. currents there is a decrease in the excitability of the neuromuscular system, resulting from an increase in the chronaxie. This is probably the explanation of the analgesic action of d'Arsonval currents. This specific electrical effect of high frequencies is directly opposed to the heating effect, which diminishes the chronaxie and increases excitability. It is shown that ordinary diathermy currents, and the h.f. field have the same action on neuro-muscular excitability in the human body. J. E. R.

1273. X-Ray Photographic Photometry. R. B. Wilsey. *Am. J. of Roentgenology and Radium Therapy*, 32. *pp.* 789–804, *Dec.*, 1934.—Whilst photographic material, as used in radiology, is primarily for recording purposes, it may be utilised for the quantitative comparison of intensity and quantity. In such uses various precautions have to be observed. The sensitivity of the film may vary and, to overcome this, comparative measurements should be made upon adjacent surfaces of the same film. In development, particularly with tank development, error may arise from differences of solution concentration, etc., and this subject is discussed, particularly with respect to agitation of the films during development. Variations may arise from the time and intensity conditions of exposure and the time-intensity relation of the particular film should previously be determined by separate experiments. Intermittency of exposure can also result in variation and this again must be determined by prior experiment. The particular photographic emulsion must be selected in respect to the wave-length of the radiation and this must therefore be of the same spectral quality, or otherwise the comparative results will be prejudiced by later development. The precision of this method of photographic photometry increases with the contrast value of the photographic emulsion. Applications of this photographic method of intensity measurement of X-rays are given, together with suitable photometers, with illustrations, in respect to measurements made upon teeth sections. B. J. L.

***1274. Simplified Mechanical Method for Radiographic Mensuration and Localisation. H. E. Kimble.** *Radiology*, 24. *pp.* 39–46, *Jan.*, 1935.—Describes an X-ray localisation device. Essentially the method is one employing a tube shift as commonly associated with the name of Mackenzie-Davidson, with the additional use of a periscopic arrangement to determine, upon the film, the exact point perpendicular to the tube anode. The periscope tube is mounted upon an overhead X-ray tube and cross wires viewed, *via* a mirror, allow a film beneath the periscope to be marked in conjunction with the image of the periscopic cross wires. The patient is then placed into position and the usual double exposure made. The X-ray film, with the double exposure, is then measured as in the above earlier method. Examples are given in relation to pelvic and cardiac measurements and of actual foreign body localisation. B. J. L.

***1275. Radiokymographic Technique. Method of Cignolini. A. Gunsett and P. Cornu.** *J. de Radiologie and d'Électrologie*, 19. *pp.* 13–18, *Jan.*, 1935.—Since the introduction of the kymographic method of examination in 1912, little attention has been paid to the procedure, until 1928, when Stumpf introduced his method of examination in which cardiac and other impulses, are recorded upon a moving film, *via*, multiple slits in a lead diaphragm. Whilst this method allowed important observations to be made in respect to cardiac action, the method has been criticised by later investigators, Bordet in 1926 pointing out that the method only permitted the amplitudes of pulsation to be recorded and not the wave form. Delherm and his collaborators modified Stumpf's apparatus by reducing the number of grid slits to 5 and making these more narrow. hott and Rosenthal utilised short horizontal slits, which could be displaced Gorizontally to different points of the cardiac shadow, this method being more recently used by Zdansky and Ellinger. Cignolini has introduced an apparatus in which the lead diaphragm is built up of 12 vertical strips, in which it is arranged to form slits at any desired cardiac region, extending the width of each strip. Record is made, after adjusting the slits to regions of the heart to be investigated, upon a film enclosed in a cassette moving in front of the grid, under time control and so arranged as to begin and end the exposure of the X-ray tube. This method gives registrations of the movements of particular regions of the heart shadows, which not only show the amplitude of pulsation, but also the form of the wave of pulsation. The authors have utilised this method and illustrations are given of the results obtained. B. J. L.

1276. Long Wave-Length Limit of Photo-Lethal Action in the Ultra-Violet. A. C. Giese and P. A. Leighton. *Science*, 81. *pp.* 53–54, *Jan.* 11, 1935.—There are considerable variations in the results of previous workers, for the long wave-length limit of the lethal action of ultra-violet light on living cells, but the majority suggest a rapid fall in the region of 3100 Å. The effects of radiations of wave-lengths 3025 Å and 3130 Å, on various types of protozoa are investigated. Precautions are taken to ensure purity in the light source and accuracy in the measurement of the incident radiation energy. Considerable variations in the lethal dose at 3025 Å were observed for different types of protozoa. At 3130 Å, even when 12 times the lethal dose at 3025 Å was given, the cells showed no change. After allowing for the differences in absorbed energy at the two wave-lengths, the result can only be explained as a sudden falling off in the photo-lethal action of the rays. J. E. R.

1277. Mathematical Aspects of Radiation Dosage. J. G. Hoffman and M. C. Reinhard. *Radiology*, 23. *pp.* 738–742, *Dec.*, 1934.—The effect of irradiation varies according to whether a stated dose is delivered in a single massive dose, or in fractional doses of the total dose. In the latter case the question of tissue recovery, between individual doses, occurs. The authors discuss this question from a purely mathematical aspect and derive a general expression for the effective dose after *n* days. Alternative doses are made equal to one another, the case being considered when the same dose is given every *m*th day, for *n* days. It is shown, that for a given method of dosage, the approximate final state of equilibrium is independent of the daily dose. When two different doses are given alternatively from day to day, the time required for the attainment of the equilibrium dose is dependent on the ratio of the two doses. Practical application of the formulæ derived is given in respect to treatment of a tumour of the neck. B. J. L.

1278. Back-Scatter for Several Qualities of X-Rays. Edith H. Quimby, C. de F. Lucas, A. N. Arneson and W. S. MacComb. *Radiology*, 23. *pp.* 743–750, *Dec.*, 1934.—When a beam of radiation strikes matter, part of the rays are scattered in all directions, the degree of scattering being dependent on the radiation quality, the material, the volume of the material, and the area of the beam. The relative amount of scattering varies in different directions and the subject is of particular importance in precise radiation therapy, as the dose delivered at any region of the subject being treated depends upon this. Attempts to measure the back-scattering, by various means, have resulted in wide disagreement of the results, particularly in respect to purely physical measurements. The authors describe and discuss an experimental arrangement utilising a new type of ionisation chamber, by which the scattering was measured from an aluminium pot lined with lead and filled with paraffin. Data are given in respect to scattered X-rays and with scattered γ-rays, over a large range of fields and qualities of radiation. The values of percentage scatter so obtained, were found to be much higher than those obtained by use of an " air wall " ionisation chamber. The amount of energy scattered varies with the irradiated area and the effective wave-length of the radiation, the effects being independent. B. J. L.

1279. X-Ray Protection. Part II. E. I. L. Cilley, E. T. Leddy and B. R. Kirklin. *Am. J. of Roentgenology and Radium Therapy*, 32. *pp.* 805–807, *Dec.*, 1934.—A continuation of a previous paper [see Abstract 4739 (1934)]. In this paper mention was made that the radiologists of the Mayo clinic had received no apparent injury in the course of their work and it was suggested that this was due to the use of a small beam of illumination. The authors have carried out direct experiment upon a wax block formed to represent the abdomen of an average patient. Data in respect to intensity measurements is given which show that danger to an examiner, in practice, is small in abdominal work, if a small field of illumination is used, as the dose he receives is roughly proportional to the size of the beam used. The procedure of the Mayo clinic is therefore considered justified. B. J. L.

1280. Comparison of X-Ray and Radium Spectra from the Standpoint of the Radiation Therapist. R. R. Rathbone. *Am. J. of Roentgenology and Radium Therapy*. 32. *pp.* 808–809, *Dec.*, 1934.—Since the therapeutic use of X-rays, generated above 200 kV, confusion has arisen in respect to the relation of such X-rays to the γ-rays of radium. A chart is given for X-rays generated between 100 and 1000 kV, relating the wave-lengths and the thicknesses of filters of varying metal and thickness as used in medical practice. The object of the chart is to corelate varying X-ray techniques. B. J. L.

1281. Relation between the D Unit and the Roentgen in Radium Therapy. G. Guében and P. Dumont. *Ann. Soc. Sci. de Bruxelles*, 54. *pp.* 280–283, *Dec.*, 17, 1934.—Several previous attempts have been made to determine the connection between the D unit of Proust and Mallet, and the roentgen, used for X-rays, when applied to the measurement of γ-rays. The results for the D unit in terms of roentgens have varied from 75 to 117. Experiments are described in which an X-ray dosemeter, calibrated in *r*, is compared with an aluminium micro-ionisation chamber calibrated in D, the comparison being made over a wide range of X-ray qualities. The number of roentgens equivalent to 1 D increases from 75 to 100 as the hardness of the X-ray beam is increased. It is suggested that a limiting value will be reached for γ-rays, in the region of 1 D = 100 *r*. J. E. R.

1282. γ-Ray Protection. G. W. C. Kaye, G. E. Bell and W. Binks. *Brit. J. of Radiology*, 8. *pp.* 6–23; *Disc.*, 24–26, *Jan.*, 1935.—The two main factors of γ-ray protection, namely, remoteness and lead shielding, are experimentally studied in routine circumstances, *e.g.*, the storage, manipulation and transport of radium, as well as its use in beam therapy, and the minimum shielding and tolerance working distance determined on the assumptions of a tolerance dose of 0·2 *r.* per day and a γ-ray dosage rate of 8 *r.* per mg. hr. at 1 cm. from a radium source. The conclusions fully support the recommendations of the British and International Protection Committees and show *inter alia* the undesirability of staff remaining in the vicinity of large quantities of radium, the high degree of protection possible with properly designed radium safes and the importance of expeditious work. The superiority of bulky postal transport boxes with only moderate lead shielding over small containers using the maximum lead shielding possible under the parcel post regulations is also established. G. E. B.

1283. Time-Intensity Factor in Genetic Effects of Radiation. H. D. Griffith and K. G. Zimmer. *Brit. J. of Radiology*, 8. *pp.* 40–47, *Jan.*, 1935.—The time-intensity factor in certain biological reactions is studied from the point of view of the Schwarzschild relation $B = It^p$, where B is the extent of the change produced by reduction of intensity I in time *t*. It is shown in a comprehensive table that only in a limited number of cases is *p* equal to unity, and in general *p* is less than unity. As regards radiologically induced genetic changes, the time factor is found to be unity and the significance of this fact with reference to radiological protection is discussed. G. E. B.

***1284. Recent Developments in Physical Instruments for Biological Purposes. L. E. Bayliss and Phyllis M. T. Kerridge.** *Journ. Sci. Instruments*, 12. *pp.* 1–5, *Jan.*, 1935.—A very short survey is made of a number of types of apparatus, which are either on the market, or have been shown at exhibitions, designed for purely biological measurements. These include apparatus for gas analysis, colorimetric and spectrophotometric analysis of blood and other fluids, measurement of blood circulation rates, measurement of impulse frequencies such as heart beats, biological investigations at sea, medical diagnosis and artificial respiration. Stress is laid on points at which new types of apparatus are required. J. E. R.

OSCILLATIONS.

1285. Theory of Ultra-Short Wave Generators. E. W. B. Gill. *Phil. Mag.* 18. *pp.* 832–838, *Nov.*, 1934.—Considers the theory of action of Barkhausen oscillators, either of the usual form or of the form in which the Lecher-wire system is connected between the filament and anode of the oscillator. It is shown that oscillations must be maintained by the anode current alone, and that the only available source of energy is the grid battery. In the paper the theoretical consequences of this assumption are explored, and account is taken of the effect of mutual repulsion of electrons, and it is shown that a satisfactory explanation of the behaviour of the oscillator can be obtained. G. E. B.

***1286. Generation of Electric Waves below 1 m. Wave-Length. K. W. Wagner and H. E. Hollmann.** *E.N.T.* 11. *pp.* 418–437, *Dec.*, 1934.—Following a discussion of the difficulties met with in apparatus for the production of electric waves of wave-length less than 1 m., an account is given of the various methods which have been used by Meissner, Englund, Hollmann, Barkhausen and Kurz, Potapenko and others for the generation of ultra-short waves. The methods include (*a*) reaction arrangements using a single valve or two valves in push-pull ; (*b*) retarding-field arrangements of the Barkhausen-Kurz type, and (*c*) magnetron arrangements. The relative merits of the different methods are pointed out and a comprehensive list of references is appended. A. W.

***1287. Direct-Reading Frequency Meter Suitable for High-Speed Recording. F. V. Hunt.** *Rev. Sci. Instruments*, 6. *pp.* 43–46, *Feb.*, 1935. —A modified two-tube thyratron inverter is employed to deliver an invariant current pulse to an indicating instrument each time the polarity of the input signal reverses. The average current in the indicator is strictly proportional to the frequency of the input signal below 7000 cycles and approximately so for higher frequencies. The current may be varied to permit a standard current instrument to be used as a direct-reading frequency indicator. The readings of the instrument are independent of the amplitude or wave form of the input signal over a wide range. When the frequency of the input signal is not constant either an accurate indication of the average frequency can be obtained or the output circuit of the instrument can be modified to permit the frequency to be recorded as a function of time. The problem of recording the frequency variations occurring in speech or singing is discussed, and other applications of the instrument are suggested. AUTHOR.

1288. Electronic Oscillations. W. A. Leyshon. *Phys. Soc., Proc.* 47. *pp.* 277–286, *March*, 1935.—The paper gives results of measurements made on the wave-length of the oscillations generated by small triodes using the positive-grid (Barkhausen-Kurz) method, in a fixed oscillatory circuit which, in most of the cases studied, was formed by the valve electrodes and leads. It was found possible, with the grid current emission-limited, to express the relation between the generated wave-length λ, the grid voltage v_g, and the plate voltage v_p, by a straight-line graph connecting $(v_g - \mu v_p)$ with λ, where $\mu\left(\left\{\frac{dv_g}{dv_p}\right\}\lambda_{\text{const.}}\right)$ was a constant for a particular valve. The results show that μ is constant whatever the value of λ generated by the triode and associated circuit. It is suggested that triodes connected in the manner described might be used as oscillation wavemeters working over a limited range. AUTHOR.

***1289. Use of Valves in Measurements. J. W. Horton.** *Elect. Engineering,* **54.** *pp.* 93–102, *Jan.,* **1935.**—For the benefit of those who may wish to use valves in meeting specific problems in the field of measurement, a comprehensive Bibliography is given including some 600 references selected from a total of about 1500 papers or books published since approximately 1920. The first portion of the Bibliography contains publications dealing with the characteristics of valves, and the second portion contains references to specific applications to measurement problems. AUTHOR.

See also Abstract 989.

PHOTOELECTRICITY.

1290. Spectral Distribution of Photo-Current in Colloidally Coloured Alkali Halide Crystals. L. Grošev. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 378–382, *Dec.* 1, 1934. *In German.*—Incorporation of a molecule or molecular aggregate in a medium of high dielectric constant leads to a lowering of the work function and hence to a shift of the limit for photoelectric excitation towards the red. Colloidal copper was introduced into NaCl and KCl electrolytically. The long-wave limit for photoelectric excitation was found by extrapolation from the wave-length—photo-current curves to be at about 600 $\mu\mu$ as against 300 $\mu\mu$ with Cu *in vacuo.* This shift is taken to prove the lowering of the work function by the medium. J. E.

1291. Photovoltaic and Photoelectric Piles with Blocking Layer. G. Athanasiu. *Comptes Rendus,* 199. *pp.* 1604–1607, *Dec.* 27, 1934.—The author contends that the operation of photovoltaic piles cannot, in all cases, be explained by analogy with the operation of photoelectric cells having a blocking layer. [See Abstract 800 (1933).] J. S. G. T.

See also Abstracts 990, 1112, 1113, 1114, 1134, 1295.

PIEZOELECTRICITY.

1292. Absence of Hysteresis in Piezoelectric Phenomena. P. Bernard. *Comptes Rendus,* 200. *pp.* 222–223, *Jan.* 14, 1935.—Known variable pressures obtained from an oil manometer were applied to quartz plates and the resulting variation of p.d. between the electrodes were recorded on an oscillograph. Pressures up to 400 kg./cm.^{2} were employed; the maximum was reached in about 0·0001 sec., and the time of decrease to zero was of the order of 1 sec. The results, taken in conjunction with the previously verified reversibility of piezoelectric phenomena [see Abstract 922 (1935)], indicate that the quantity of electricity liberated is independent of the rate of application of pressure, and that the phenomena are not subject to hysteresis. P. V.

1293. Proper Frequencies of Piezoelectric Quartz Plates with Vibration Excited in the Direction of the Thickness. L. Bergmann. *Ann. d. Physik,* 21. 6. *pp.* 553–563, *Jan.,* 1935.—Investigation was made of the elastic harmonic vibrations produced piezoelectrically in the vibration in the direction of the thickness of excited quartz plates. Four plates of different sizes were examined. The observation of the harmonics was made by an optical method. From the measurements it is found that the harmonics obey the harmonic law. There are however deviations between the measured fundamental frequency of the respective plates and that calculated from the harmonic vibrations. J. J. S.

See also Abstracts 978, 989, 1237.

THERMIONICS.

1294. Shot Effect and Thermal Agitation in an Electron Current Limited by Space Charge. G. L. Pearson. *Physics*, 6. *pp*. 6–9, *Jan*., 1935.—Experimental evidence is presented which shows that shot effect is decreased by space charge and that the internal impedance of a valve is subject to thermal agitation. AUTHOR.

1295. Models of the Superposition and Interpenetration of Components in Gas Mixtures Adsorbed upon Thermionic, Photoelectric and Catalytic Surfaces. Part I. M. C. Johnson. *Phys. Soc., Proc.* 47. *pp*. 287–305, *March*, 1935.—Models of intermolecular attraction and repulsion are developed to represent the penetration of one adsorbed substance through another. Simplified models are adopted to enquire what properties a molecule must possess if it is either to penetrate and replace, or to remain superposed upon and stabilise, a previously adsorbed group of molecules. The range of models is chosen to cover certain main features of O, H, Cs and inert gases, adsorbed in dissociated, ionic, and other states upon a tungsten surface. Some of the conditions are found whereby any given metal-gas sequence is able to rearrange its layers into a stable equilibrium independent of the order in which the components were originally deposited. A. W.

***1296. Production of an Ion Current in a High Vacuum by Means of a Magnetic Field. A. A. Slutzkin, S. J. Braude and I. M. Wigdortschik.** *Phys. Zeits. d. Sowjetunion*, 6. 3. *pp*. 268–279, 1934. *In German*.—By means of a special apparatus constructed somewhat like a triode of unusual design and having the grid and plate at a negative potential with respect to the filament it was found that an ionic current could be produced when a longitudinal magnetic field was applied (*i.e.*, parallel to the filament and cylindrical anode). Even at a vacuum corresponding to about 10^{-5} to 10^{-6} mm. mercury currents of 140 μA. could be produced. G. E. B.

1297. Accommodation Coefficient of Mercury Ions on a Mercury Surface. R. C. Mason. *Phys. Rev.* 47. *pp*. 241–248, *Feb*. 1, 1935.—The pressure exerted on a mercury surface, to which were attracted mercury positive ions produced in a mercury arc, was measured by a modified form of Chattock micromanometer. The pressures found were entirely too large to be given by the neutralised ions alone, even if they had an accommodation coefficient of zero. The correction for the general heating of the mercury surface was not large. The most probable explanation is that each ion sputtered a large number of atoms and that the reaction on the surface of these escaping sputtered atoms gave the observed forces. If a is the accommodation coefficient, defined as the fraction of the energy of the impacting ions which is not carried away by the sputtered atoms; n, the number of atoms sputtered per ion; V_s, the electron volt equivalent energy of the sputtered atoms, then the experiments set these limits for 1000 volt ions: $100 > n > 7 \cdot 8$; $0 \cdot 92 > a > 0$; $0 \cdot 78 < V_s < 128$. The force exerted on the mercury surface was a linear function of the energy of the ions, represented approximately by (F/i)(dynes/ampere) $= 9V$(volts). From a critical examination of the sources of error, it seems the true forces must have been greater than the values used above. AUTHOR.

THERMOELECTRICITY.

See Abstract 972.